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**Economic Impacts of Pulp and Paper Industry Compliance
with Environmental Regulations, Volume II. Price and
Demand Effects on the Industry's Major Product Sectors**

Arthur D. Little, Inc., Cambridge, Mass.

Prepared for

**Environmental Protection Agency, Washington, D.C. Office of Planning and
Evaluation**

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ECONOMIC IMPACTS OF PULP AND PAPER INDUSTRY COMPLIANCE WITH ENVIRONMENTAL REGULATIONS

VOLUME II

Price and Demand Effects on the Industry's Major Product Sectors



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VOLUME II

**PRICE AND DEMAND EFFECTS ON THE INDUSTRY'S
MAJOR PRODUCT SECTORS**

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I. INTRODUCTION

This volume addresses the supply/demand/price impacts for each of the pulp and paper industry's major product sectors. It brings together all of the descriptive information, data, and econometric analyses which were applied to estimate the price/demand effects of the studied environmental regulations and the potential for short-run shortages. It describes the economic characteristics of each product sector in sufficient detail to allow readers unfamiliar with the industry to understand its key economic characteristics and how price increases caused by regulations and accompanying restrictions in potential demand compare with historical price, demand and supply trends.

For the purposes of this analysis, Arthur D. Little, Inc. subdivided the paper industry into 14 major product sectors and selected, of these, 10 as representative products or product groups for the econometric analyses (Table I-1). To provide a complete description of the entire paper industry and to facilitate future studies, Arthur D. Little also outlined the economic characteristics of the three remaining product sectors: bleached packaging papers, construction paper, and specialty papers. Available historical price data for bleached packaging and construction papers are not sufficiently accurate for econometric analyses. Specialty papers were excluded from the impact analyses because water effluent guidelines have not yet been proposed for this sector.

The 14 major product sectors were chosen primarily on the basis of common markets or applications and also to combine products that usually are produced together. In some cases, the products within a sector are complementary; in others, they compete directly with each other (and sometimes with nonpaper products) for various end uses.

A. PURPOSE AND SCOPE

To assist various government agencies in making decisions concerning environmental regulations for the U.S. paper industry, the EPA retained Arthur D. Little to undertake a comprehensive study aimed at measuring the potential economic impacts resulting from the industry's total cost to comply with the following existing and proposed regulations:

- **Water Regulations** — those issued by EPA for existing and new capacity. Two levels of control for the existing industry are assessed — that for compliance with BPT ("best practicable control technology currently available") which is required for 1977 and BAT ("best available technology economically achievable") which is required for 1983. New capacity control costs are based on the New Source Performance Standards (NSPS) currently in effect. These regulations do not affect pretreatment standards and other costs associated with use of municipal treatment facilities, but the latter were considered in the mill closure analysis.
- **Air Regulations** — those issued by states (State Air Quality Implementation Plans — SIP) for the existing industry, and those issued by EPA as they apply to new capacity.
- **Noise Regulations** — those issued by the Occupational Safety and Health Administration (OSHA) for compliance with a 90-dBA noise level using engineering and/or administrative controls to achieve compliance. Noise regulations apply equally to both existing and new capacity.

TABLE 1-1

U.S. PRODUCTION AND TRADE BY PAPER INDUSTRY PRODUCT SECTOR, 1974
(Thousands of Short Tons)

<u>Product Sector</u>	<u>Production</u>	<u>Imports</u>	<u>Exports</u>	<u>Apparent Consumption</u>
Containerboard				
Unbleached Kraft ¹	13,333	--	1,763	11,590
SSBC Medium ¹	4,175	10	71	4,116
Packaging Papers				
Unbleached Kraft ¹	4,197	142	224	5,323
Other	1,207			
Recycled Paperboard ¹	7,634	24	203	7,375
Construction Paper	1,764	60	26	1,798
Market Pulp				
Bleached Paper Grade ¹	3,296	2,219	1,557	3,958
Dissolving ¹	1,611	226	806	1,031
Printing/Writing Papers ¹	10,887	217	302	10,802
Bleached Board and Bristol ¹	4,979	--	375	4,604
Tissue ¹	4,086	--	24	4,062
Uncoated Groundwood Papers				
Newsprint ¹	3,480	7,398	188	10,690
Groundwood Specialties	1,246	117	53	1,310
Specialty Papers ²	731	8	128	611
TOTALS	62,626	10,421	5,780	67,267

¹Denotes sectors which were analyzed econometrically.

²Includes special industrial papers and wet machine board.

SOURCE: U.S. Department of Commerce and American Paper Institute.

Three types of existing or proposed environmental regulations were *not* included in these economic impact analyses:

- All regulations affecting woodland management (e.g., use of herbicides and pesticides), harvesting practices, and alternate timberland uses;
- Regulations which mandate fuel switching and/or require SO₂ removal. (This study assumes the use of low-sulfur fuel.)
- "Nonsignificant deterioration" regulations under consideration by Congress which would tighten current air emission limitations for new or expanded pulp and paper mills; and
- Priority pollutants regulations, currently being studied by the EPA for possible inclusion in the 1985 water effluent guidelines.

The study analyzes cost recovery impacts of the above water, air, and noise regulations on the pulp, paper, and paperboard product sectors of the total paper and allied products industry. Thus, the analysis does not include costs or impacts associated with timberlands, or paper/paperboard converting operations (except in cases where converting is done at the paper mill). The study also excludes specialty paper products, for which Federal water effluent guidelines have not yet been proposed; such products account for less than 2% of total U.S. paper and paperboard production. Specific product sectors studied are:

Sector	% of U.S. 1974 Capacity
Unbleached Kraft Paper	7.1
Unbleached Kraft Paperboard	22.6
NBBG Corrugating Medium	7.2
Recycled Paperboard	14.0
Construction Paper	3.6
Bleached Market Pulp	7.8 ¹
Dissolving Pulp	3.8 ¹
Printing/Writing Paper	18.8
Bleached Board and Bristol	6.3
Tissue	7.0
Newsprint and Uncoated Groundwood	8.1
Bleached Packaging Paper	2.1
Total (Excluding Pulp and Construction Board)	98.7

1. Based on total pulp.

In 1975, the above product sectors accounted for about 45% of the paper and allied products industry's sales, 55% of its assets and 42% of its employment.

The report assesses the industry's incremental costs to meet the environmental regulations defined above. Then it estimates the following economic impacts of these costs on the product segments they affect directly and on the industry and economy as a whole:

Price and Demand Effects
 Short-Term Capacity Constraints
 Secondary Impacts on Suppliers
 Closure and Employment Effects
 External Financing Requirements
 Balance of Trade Effects

B. KEY BASES OF ANALYSIS

The results of this analysis should be interpreted in the light of the following key assumptions and study parameters:

1. The base case assumed that regulatory timetables and standards will be enforced with no exceptions. It is already evident that this assumption does not hold in the case of EPA's MCL water guidelines which required effective treatment systems to be operating by July 1977; a number of mills report that they will be unable to meet this deadline and some have been allowed to continue with lower quality standards in 1978/1981. A sensitivity analysis was performed to test the capital effects of stretching the effective compliance date to January 1981. The 1977 closure estimates excluded any mill that indicated it had obtained a variance in the 1977 guidelines, or timetables; however, such mills were often judged to be likely candidates for closure by 1981.

2. Starting dates for the forecasts were: January 1976 — for the industry's capital and financing requirements; January 1975 — for environmental control and operating costs (including capital recovery). The earlier date was used for operating costs because the 1975 recession prevented most paper companies from raising prices in 1975 and 1976; thus the incremental costs incurred since January 1975 generally are not reflected in 1976 prices.

3. Product quality will not change significantly through 1981. There has been much industry discussion about employing lower brightness, higher yield pulp in their products, thus reducing pollution loadings as well as costs. However, as yet, there is no evidence that this trend has begun; thus, it would be very speculative to predict its timing and effects.

4. Competitive pricing is assumed in all price, demand, and capacity forecasts. To the extent that Federal price controls or guidelines are imposed and sustained, the capacity and capital requirement forecasts made in this report would be altered.

5. Cost models and dollar projections employ constant 1975 dollars, unless otherwise noted. This assumes no "real" inflation relative to the general GNP deflator. If the paper industry experiences real cost inflation, its price, capital, and financing requirements will be higher than that projected here. However, its relative cost recovery price increases resulting from the studied regulations would not change.

6. Chase Econometric's, May 17, 1976, *Economic Growth Forecasts* for the Council on Environmental Quality were used as the bases for the demand and capacity forecasts. The industrial production index and GNP series in the Chase forecasts reflect a mild recession in 1976-1979 followed by four years of sustained growth to 1981. Chase Econometrics predicted average annual growth rates of 4.3% for GNP and 6.5% for industrial production, 1976-1981.

II. OVERVIEW

This chapter summarizes the impact of the studied environmental regulations on the individual pulp and paper product sectors.

A. MARKET STRUCTURE

Most of the paper industry and its major product sectors are quite competitive. Market share concentration of the industry's largest firms clearly illustrates this. At the level of aggregation of a 4-digit SIC code, an industry is generally considered oligopolistic if the four-firm concentration ratio is more than 50% and the eight-firm concentration ratio 65%. Throughout the U.S. economy, the concentration ratio for specific products is generally higher than that for the corresponding four-digit SIC industry without oligopoly being indicated. The product sectors described in Chapter III are generally five- to seven-digit SIC product categories (e.g., linedboard is a seven-digit product).

Table II-1 shows that all sectors except dissolving pulp (where the largest firm has 44% of the market) uncoated groundwood and wet machine board have low to moderate concentration ratios. Environmental regulations will contribute to a trend toward increasing concentration in the paper industry by increasing the minimum efficient scale of new mills and generally increasing barriers to entry by making it more difficult for small to medium firms to expand capacity.

B. LONG-RUN PRICE IMPACTS

In the long run, prices in the pulp and paper industry will primarily reflect new mill costs and profit margins. Long-run price impacts for each product sector were estimated using new mill cost models for representative products in each product sector. The calculated prices were consistent with the discounted life-cycle cash flows of the mills, using a 10% cost of total capital. Comparison of the projected price with environmental controls and the price without yielded the estimated long-run price impact.

The relative price impacts vary by product sector, from an estimated 15.0% for S8880 corrugating medium to a low of 4.1% for tissue (Figure II-1 and Table II-2). The variation in impact is a function of product value as well as the environmental costs associated with producing it. For example, the long-run price increase due to the studied regulations is estimated to be \$11 per ton for both S8880 corrugating medium and tissue. However, because of different product values this increase translates into a relative price impact of 15.7% for S8880 and 4.1% for converted tissue. The other reasons for variability in impact are process-specific. For example, a stand-alone S8880 mill has process characteristics which make effluent more costly to control than most other sectors.

C. COST RECOVERY REQUIREMENTS FOR THE EXISTING INDUSTRY

The prices required for existing pulp and paper mills to recover their incremental environmental could reflect an estimate of intermediate-run price impacts during the period 1977-1981. Existing mills are required to comply with regulations similar to those for new mills, but they generally have implemented some environmental controls already. In estimating price increases necessary for existing mills to recover incremental costs of compliance with the studied regulations, it was assumed that none of these costs were reflected in the base 1975 market prices which were held down by the 1974-1975 recession. The required price increase was computed by

TABLE 11-1
CONCENTRATION IN PULP AND PAPER INDUSTRY

	1975		Total Number of Firms
	Percent of U.S. Capacity Top 5 Firms	Top 8 Firms	
Bleached Boards & Bristles	44.9	67.1	26
Bleached Packaging Paper	36.4	49.9	40
Containerboard			
NSB Corrugating	27.8	46.2	21
Unbleached Kraft Linerboard	14.8	57.0	28
Construction Paper	57.7	81.0	23
Market Pulp			
Bleached Paper Grade**	30.9	50.5	25*
Dissolving	77.0	100.0	8
Newspaper	44.0	64.5	14
Printing & Writing	26.1	42.1	71*
Recycled Paperboard	23.3	38.2	101
Specialty Paper	25.7	43.1	51*
Tissue	55.8	77.6	51*
Unbleached Kraft Paper	41.0	66.9	38*
Uncoated Groundwood	65.2	84.8	20*
Wet Machine Board	77.9	92.0	11

*Approximate number of producers.

**North American producers and capacity.

SOURCE: ADL estimates. See Vol. 11--Product sector descriptions for basis of estimates.

FIGURE 3-7
LONG-RUN PRICE INCREASE RESULTING FROM
ENVIRONMENTAL REGULATIONS IN THE PULP AND PAPER INDUSTRY*

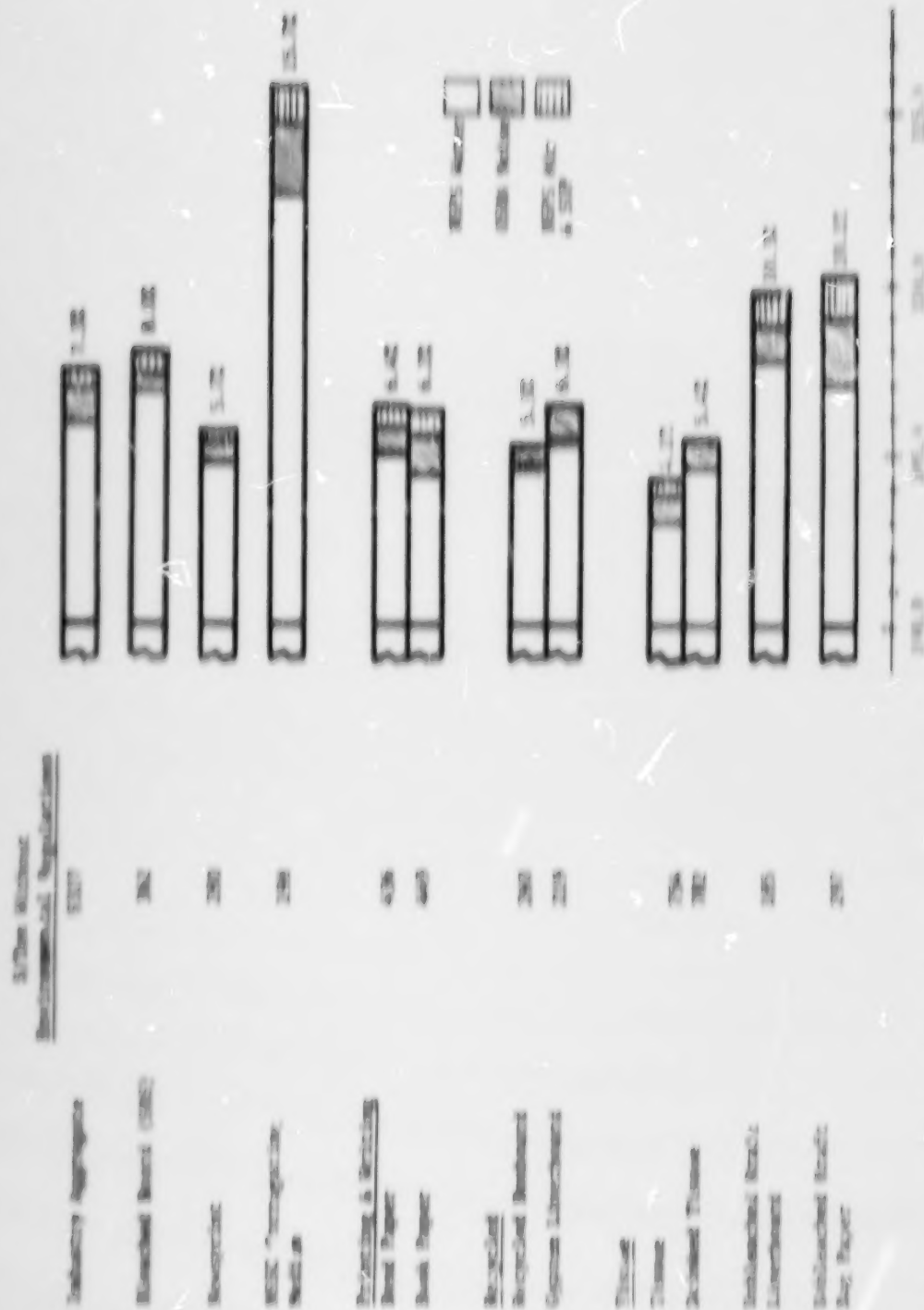


TABLE 11-2

**LONG-RUN PRICE IMPACTS
OF STUDIED ENVIRONMENTAL REGULATIONS**

Sifton Without Environmental Regulations	Increase in MSPS Rate		Price/Rise Price			Price After Conclusive Increase Percentage	
	\$	%	\$	%	\$	%	
Bleached Board & Briscals	52.6	6.67	53	0.52	53	0.52	
Conclusive Board							
MSPC Conclusive Board	75	12.6	2	1.8	4	2.1	
Unbleached Kraft: Linenboard	185	7.5	2	1.1	2	1.1	
Unleached	185	4.1	1	0.3	3	1.8	
Printing & Writing							
Blank Paper	436	4.8	3	0.7	4	0.9	
Blank Paper	436	4.7	3	0.7	4	0.9	
Recycled Board							
Recycled Board	28	4.6	1	0.4	2	0.9	
Unleached Kraft: Linenboard	28	5.9	1	0.5	2	0.9	
Unleached Kraft: Linenboard							
Unleached Kraft: Linenboard	28	2.9	3	0.4	6	0.9	
Unleached Kraft: Linenboard	28	3.8	5	0.6	9	1.7	
Unleached Kraft: Linenboard	28	7.1	3	1.8	6	2.9	
Unleached Kraft: Linenboard	28	5.8	2	0.6	3	0.9	

Source: EPA, 1970, p. 100.

adding the estimated incremental operating costs¹ to the investment expenditures (Table II-3), which were annualized by the level recovery method, using a 10% cost of total capital. The annualized costs were converted to a per ton cost based upon the capacity existing in 1975 that was estimated to still be in operation by 1977 and 1983.

The required price increases for the existing industry to recover the incremental cost of the studied regulations range from a high of 7.9% for uncoated groundwood to a low of 0.7% for construction paper (Table II-4). As was the case with the estimated long run impacts, most of the impact is from water regulations and the relative impact differences were caused by unit value differences and process-specific factors.

D. OUTPUT EFFECTS

As a result of the price increase caused by environmental regulations, reductions in quantity demanded will occur for products with a price elasticity of demand greater than zero. Price elasticities of demand calculated from econometric models are consistently inelastic, ranging from 0.1 for bleached board and bristle to 0.96 for unbleached kraft paper with a weighted average of 0.57 (Table II-5).

The elasticity of demand indicates the reduction in output that will occur as a result of a price increase. For example, if the price of unbleached kraft bag paper increases by 10%, the quantity demanded will fall by 9% because the price elasticity of demand is 0.9.

¹ See Volume I, Chapter 3.

TABLE 11-3

INVESTMENT REQUIRED BY REINING MILLS
TO COMPLY WITH STUDIED REGULATIONS

	(Millions of dollars)				
	1977 Value	1983 Value	PIP Air	GHHA Noise	Total
Bleached Board & Bristols	9177	9164	9108	919	9439
Bleached Pkg.	54	36	31	6	117
Construction Paper	34	24	9	23	90
Dissolving Pulp	102	92	22	9	185
Newsprint	162	91	84	29	336
NSBC Medium	112	108	28	30	278
Printing & Writing	595	363	192	101	1,252
Recycled Paperboard	187	94	34	55	330
Tissue	268	155	68	48	539
Unbleached Kraft Paper	122	90	76	15	303
Unbleached Kraft Paperboard	373	258	232	50	913
Uncoated Groundwood	72	41	20	15	138
Total	\$2,250	\$1,610	\$860	\$400	\$4,920

Source: ADL estimates.

TABLE III-4

PRICE INCREASE MESSAGE FOR
EXISTING MESSAGES TO REMAIN THE COST OF
SELECTED ENVIRONMENTAL REGULATIONS

1975 Price	1977 Rec. r		1983 Rec. r		SUP Act		1983 Message		Cumulative	
	\$	%	\$	%	\$	%	\$	%	\$	%
Bleached Boards & Bristles	\$ 8.06	2.32	\$6.11	1.72	\$2.79	0.82	\$.67	0.72	\$17.65	5.08
Bleached Pkg.	10.36	2.7	6.37	1.6	2.47	0.6	.86	0.7	28.34	5.3
Construction Paper	3.50	1.4	2.57	1.0	.91	0.4	2.12	0.9	9.10	3.7
Dissolving Pulp	13.68	3.5	9.69	2.4	1.86	0.5	.58	0.1	26.01	6.5
Newsprint	10.67	4.0	5.99	2.3	1.31	0.9	1.13	0.5	28.38	7.7
SSSC Roll-in	5.00	2.6	4.29	2.2	1.21	0.5	1.26	0.7	11.75	6.1
Printing & Writing	12.79	2.2	7.50	1.5	3.09	0.5	1.60	0.2	24.98	4.2
Recycled Paperboard	5.08	2.4	1.61	0.7	.89	0.4	1.29	0.6	6.86	4.1
Tissue	15.30	2.0	8.82	1.1	2.57	0.3	2.12	0.3	28.61	1.7
Unbleached Kraft Paper	6.26	2.6	4.97	2.1	2.50	1.0	.62	0.3	14.35	5.9
Unbleached Kraft Paperboard	5.83	3.6	4.73	2.4	2.41	2.2	.89	0.4	13.66	7.0
Uncoated Crumpled	11.90	3.6	10.79	3.2	2.52	0.9	1.26	0.5	26.57	7.9
Weighted Ave.	\$8.40	2.92	\$5.46	1.92	\$2.30	0.7	\$1.18	0.42	\$17.12	5.91

SOURCE: All estimates. See Volume 1, Chapter 3 for details of cost data and Volume 1, Chapter 4, for a cost sensitivity analysis (range of cost-price estimates).

TABLE II-5

PRICE ELASTICITY OF DEMAND
PULP, PAPER, AND PAPERBOARD PRODUCTS

Product	Estimated Elasticity *	95% Confidence Interval
Bleached Board & Bristol	.18	± .18
Bleached Market Pulp	.46	± .35
Dissolving Lulp	.63	± .32
Newsprint	.22	± .09
SSSC Corrugating Medium	.35	± .09
Printing & Writing Paper	.26	± .14
Recycled Paperboard	.46	± .35
Tissue	.45	± .18
Unbleached Kraft Linerboard	.50	± .27
Unbleached Kraft Paper	.90	± .26
All Paper & Board		
Eq. 1: Weighted Sector Prices	.37	± .08
Eq. 2: Wholesale Price Index	.57	± .27

*Equation for Arc elasticity of demand:

$$e = \frac{\Delta Q}{(Q_1 + Q_2)/2} \div \frac{\Delta P}{(P_1 + P_2)/2}$$

Source: Derived from econometric models estimated by Arthur D. Little, Inc.

III. PRODUCT SECTOR ANALYSES

A. CONTAINERBOARD

1. Product Description

Containerboard is the largest single product category in the United States paper industry. It accounted for more than 60% of total paperboard production and more than 30% of total paper and paperboard production in 1973. This category includes a series of products which are used primarily in the construction of corrugated shipping containers for secondary packaging purposes:

- (1) Linerboard, made either from unbleached kraft pulp, wastepaper, or a combination of both;
- (2) Corrugating medium, made either from a combination of semi-chemical (NBSK) pulp and wastepaper, or entirely from wastepaper; and
- (3) Container chip and filler board, made entirely from wastepaper.

Linerboard provides the top and bottom substrate of a corrugated container. Corrugating medium is the fluted material between the linerboard layers. Container chip and filler board is used to form the partitions or to line the inside of the corrugated container.

Unbleached kraft linerboard and semi-chemical corrugating medium dominate this product sector, accounting for about 91% of 1973 containerboard production (Table III-1). This description will emphasize these products; the supply/demand/price characteristics of the recycled products will be included under the recycled paperboard section.

Since linerboard forms the surface layer of the corrugated sandwich, its chief function is to provide the strength required of the container, primarily resistance to bursting and crushing. Standard physical requirements for corrugated containers in the United States are set forth in Section 3 of Rail Rule 41, which governs shipping containers for goods shipped by rail across state borders. Similar standards for containers used for goods shipped by truck are contained in Rule 222 of the National Motor Freight Classification. Unbleached kraft linerboard produced in the United States (typically at a basis weight of 42 lb/1000 sq. ft.) fully provides the strength required to meet Rules 41 and 222. The basis weight of recycled linerboard must be increased to more than 42 lb/1000 sq. ft. if this material is to match the strength of 42 pound kraft liner.

The chief function of corrugating medium is to provide a low cost material for the corrugated inner layer. Tearing resistance and folding properties can be minimal, since these properties are provided by the linerboard layers. Thus, both semi-chemical and recycled corrugating medium (the latter containing more than 25% wastepaper) are applicable for this use. The most common basis weight for corrugating medium is 26 lb/1000 sq. ft.

Container chip and filler board generally consists of paperboard that is lighter than 20 lb/1000 sq. ft. It is employed either as single sheets or as the facing of corrugated materials used for interior packaging such as partitions, dividers, pads, and cushioning.

TABLE 111-1

M. R. CONTAINERBOARD PRODUCTION, 1973¹
BY MAJOR PRODUCT

	<u>Thousand tons</u>	<u>%</u>
<u>Linerboard</u>		
Unbleached Kraft	12,664 ²	68
Recycled	<u>289</u>	<u>1</u>
Sub Total	<u>12,953</u>	<u>69</u>
<u>Corrugating Medium</u>		
Semi-Chemical	4,830 ³	23
Recycled	<u>1,129</u>	<u>6</u>
Sub Total	<u>5,959</u>	<u>29</u>
<u>Container Chip and Filler Board</u>		
Recycled	<u>312³</u>	<u>2</u>
 Total	 <u>18,633</u>	 <u>100</u>

¹Includes Exports

²Includes 128,000 tons of Solid Bleached Board

³Includes small amounts of Unbleached Kraft

SOURCE: API, Statistics of Paper and Paperboard, 1974

2. Demand

In 1973, apparent domestic containerboard consumption was 16.9 million tons. Demand for the products in this group is directly related to the shipping container requirements of the full spectrum of American industry; thus, it is strongly influenced by the main macro-economic indicators including the industrial production index and GNP.

Most containerboard material is consumed in the major metropolitan areas where the box plants that convert containerboard into corrugated containers are concentrated to be near their customers. About 38% is consumed in the Midwest, 26% in the South, 18% in the Northeast, and 18% in the West.

Table III-2 shows a breakdown of 1973 shipments of corrugated box by major end use. Here it can be seen that food applications are the most important end uses for corrugated shippers. Paper, wood and allied products and glass products are also important end use market areas.

The only real competitive threat to corrugated shipping containers has come from the use of heavy-gauge shrink plastic film. This film can be wrapped around a pallet of packages and then shrunk by the application of heat to hold the load securely. However, because of the superior cost/performance characteristics of the corrugated containers, shrink film now competes only in limited applications. Other products have not encroached significantly into corrugated container markets.

Probably because corrugated containers have become established as an essential low-cost packaging material with few substitutes, its price elasticity of demand is low. Arthur D. Little's econometric analysis indicates price elasticities of 0.50 for linerboard and 0.35 for NBBG medium.

3. Supply

U.S. containerboard capacity was about 19.2 million tons in 1973. The industry has announced plans to expand capacity at the rate of about 3.0% per year (1976-1979). Interestingly, virgin liner and medium capacity will expand more slowly (2.7% per year) than the recycled products; this is a reversal of the historical pattern and reflects mounting expansion obstacles for virgin pulp products.

About 80% of U.S. linerboard production is in the South and the remainder is in the West. Production of semi-chemical corrugating medium is distributed roughly 60% in the Northeast and North Central regions, 35% in the South, and 5% in the West (in proportion to the distribution of the hardwood pulpwood used for this product). Recycled containerboard products are manufactured near the major population centers.

Although there are about 28 U.S. suppliers of kraft linerboard and NBBG medium, eight of these account for 57% of total linerboard capacity, while 20 companies share the remaining 43% (Table III-3). Eight companies account for 40% of total NBBG corrugating medium capacity, while about 21 companies share the balance (Table III-4). Production of recycled containerboard products is more fragmented.

The leading containerboard suppliers are large, integrated and financially strong manufacturers. Being a low-cost producer is a key to success. This implies that substantial vertical integration is desirable — both backward to the control of pulpwood resources and forward to the converting of corrugated containers.

TABLE 111-2

CORRUGATED SHIPPERS CONTAINED PER CASE¹
(1973)

	Share of Total Shipments (Percent)	
Food		
Meat Products	9.4	
Canned Fruits & Vegetables	8.1	
Beverages	3.6	
Bakery & Confectionary Goods	3.1	
Fresh Fruits & Vegetables	2.7	
Dairy Products	1.9	
Other	6.2	
Subtotal		27.8
Paper, Wood & Allied Products		19.3
Glass Products		9.2
Chemicals & Allied Products		6.6
Electrical/Electronic Equipment		6.4
Metal & Fabricated Metal Products		6.1
Rubber & Misc. Plastic Products		4.3
Textile Products		4.0
Furniture & Fixtures		3.3
Transportation Equipment		2.6
Machinery		2.4
Other		12.0
Total		100

¹ Basis: Square Footage Shipped

Source: Fibre Box Association

TABLE III-3

CONCENTRATION OF U.S. KRAFT LINERBOARD SUPPLIERS, 1975

	<u>% of U.S. Total</u>	<u>Number of Mills</u>
International Paper	11.7	5
Weyerhaeuser	8.4	3
Georgia Kraft (Head & Inland Containers)	7.8	3
St. Regis	6.9	3
Union Camp	6.8	2
Container Corp. of America	5.6	2
Owens Illinois	5.0	2
Continental Can	<u>4.8</u>	2
Top eight companies	57.0	
Others (about 20 companies)	<u>43.0</u>	
Total (about 28 companies)	100.0	

SOURCES: Lockwood's directory of the Paper and Allied Trades, 1975.
 Arthur D. Little, Inc., estimates.

TABLE 111-4

CONCENTRATION OF U.S. NSSC CORRUGATING MEDIUM SUPPLIERS, 1975

	<u>% of U.S. Total</u>	<u>Number of Mills</u>
Owens Illinois	8.9	2
International Paper	7.5	2
Weyerhaeuser	6.5	3
Container Corp. of America	4.9	2
Menasha	4.9	2
Packaging Corp. of America	4.8	1
Hoerner-Waldorf	4.6	2
Stone	<u>4.1</u>	1
Top eight companies	46.2	
Others (about 21 companies)	53.8	
TOTAL (29 companies)	100.0	

SOURCE: Lockwood's directory of the Paper and Allied Trades, 1975.
Arthur D. Little, Inc., estimates.

Industry practice confirms this view. The leading containerboard producers listed in Tables III-3 and III-4: (1) are integrated to pulp; (2) control a significant portion of the woodlands that support their pulp mills; and (3) are forward integrated to the production of corrugated shipping containers. Furthermore, roughly 80% of total corrugated container shipments in 1974 was generated by integrated linerboard suppliers.

Because of the barriers to entry, posed primarily by the vertical integration requirements in linerboard, the containerboard industry will become more concentrated. New entrants into this business are unlikely except through the acquisition of existing firms or possibly entry into the recycled products components business.

4. Prices

Containerboard is a commodity-oriented industry that offers little opportunity for product differentiation or brand identity. Orders go to the supplier that is most readily available and offers the lowest price. Thus, selling price is the major marketing tool.

Table III-5 shows the price increases which have occurred between 1971, when average operating rates were at the 86%:90% level; 1974, when operating rates were at a practical maximum (about 96%:99% of capacity), and the 1975 recession when operating rates averaged 88%:89%. From 1973 to 1974, prices increased between 34% and 41%, depending on grade. These significant price increases reflected not only a tight supply/demand situation, but also pass-through of accumulated cost inflation that producers were unable to pass on when price controls were in effect. Prices remained firm in 1975 despite low capacity utilization primarily because of production curtailments to hold inventories in check.

TABLE III-5

CONTAINERBOARD PRICE TRENDS
(Annual Average Contract Prices, \$/Ton)

Product	1971	1972	1973	1974	1975
Unbleached Kraft Linerboard	112	126	142	180	195
NBSG Corrugating Medium	112	119	136	169	193
Recycled Corrugating Medium	108	116	130	164	185
Container Chip and Filler	115	120	140	185	188

SOURCE: Arthur D. Little, Inc., Industry Survey.

5. Import/Export Balance

In addition to meeting domestic consumption, large amounts of linerboard are exported to foreign markets. About 1.6 million tons of unbleached kraft linerboard (13% of total U.S. production) were exported in 1973. Domestic linerboard producers are in a favorable export position because their wood is less costly, and their mills larger and more efficient than those of producers in the other major producing regions (Canada and Scandinavia). U.S. Exporters ship from the Pacific Northwest to Asian and Latin American markets and from the South to Western European and Latin American markets. The economics of production and shipping do not favor export of other containerboard grades, such as corrugating medium or the recycled products. Thus, these are not significant export products.

There are no significant imports of containerboard materials. Consequently, this industry has a favorable impact on the U.S. balance of payments.

6. Price Impacts

The relative long-run price increases estimated for the two container board products studied (linerboard and NSSC corrugating medium) will be higher than average. These products have a lower than average unit value and the impact upon NSSC mills is large because of the particular characteristics of the process.

As shown in Table III-6, the long-run price increase in linerboard due to the studied regulations will be 10.3%. The existing industry requires a 7.0% price increase to recover the incremental costs of compliance with the studied regulations.

The long-run price increase in NSSC corrugating medium due to the studied regulations is 15.0% (Table III-7). This figure, however, is based upon a stand-alone NSSC mill integrated to pulp and it is unlikely that such a mill would be constructed. The more likely situation is construction of an NSSC mill at a site with linerboard to minimize effluent control costs. This 15.0% estimate therefore is in the upper range of the likely price impacts.

In sharp contrast, existing NSSC mills will require a 0.1% price increase to recover the incremental cost of compliance with the studied regulations.

Linerboard and NSSC corrugating medium are bonded together to form cartons. The final consumer will see price increases in products that are shipped in the corrugated boxes. For example, the price impact on canned vegetables will be 0.16% of the selling price because of the combined impact of linerboard and NSSC price increases.

7. Output Effects

The price elasticity of demand was estimated at 0.60 for linerboard and 0.35 for NSSC corrugating medium. This means that the long-run price increase of 10.3% in linerboard will result in a 6.2% decline in demand and the 15.0% increase in NSSC price will result in a 5.5% decline in demand.

TABLE III-6

EFFECT OF ENVIRONMENTAL REGULATIONS
ON UNBLEACHED KRAFT PAPERBOARD PRICES

Environmental Regulation	Printing Industry		Long-Run Price Effect	
	Investment Required \$ Millions	Necessary Price Increase \$/Ton 1975 Price ²	\$/Ton	% Baseline Price ³
IRA Paper				
1977	13073	\$5.38	1.02	-
1980	25	4.73	2.4	-
1981	1	-	-	8.12
Industrial Air				
1977	234	2.42	1.2	-
1981	1	-	-	1.1
Water Pollution				
1977	95	.48	.06	1.1
Total	9913	\$13.21	7.08	10.32

¹1975 Price²Baseline Price³Per Capacity Reduction - 1%

SOURCE: Arthur D. Little, Inc., estimates.

TABLE III-7

EFFECT OF ENVIRONMENTAL REGULATIONS
ON NISC CONCENTRATING MEDIUM PRICES

Environmental Regulation	Existing Industry			Long-Run Price Effect	
	Investment Required \$ Millions	Necessary Price Increase \$/Ton	1975 Price ¹	\$/Ton	2 % Baseline Price
EPA Motor					
1977	\$112	\$5.00	2.68	—	—
1983	108	4.28	2.2	—	—
MSRS	—	—	—	25	12.62
Federal Air					
MSRS	28	1.21	0.6	—	—
MSRS	—	—	—	2	1.0
NISCs Motor	30	1.26	0.7	4	2.0
Total	\$238	\$11.75	6.12	\$31	15.62

¹1975 Price \$193²Baseline Price \$190

See Capacity Differential: 14

SOURCE: Arthur D. Little, Inc., estimates.

8. Supply/Demand Balance

NSSC corrugating medium will face a tight capacity situation in 1977-78 if demand is ebullient. Both NSSC and unbleached kraft board face potential tight capacity situations in 1982-83 (Figures III-1 and III-2).

Since no mill shutdowns are forecast for this sector, any tight capacity will be the result of demand growing at a faster rate than capacity expansions and not environmentally-related pollution closures.

B. PACKAGING PAPERS

1. Product Description

Table III-8 lists the major products that comprise the packaging papers sector and shows their 1973 shipments. This sector consists of two major categories:

- Unbleached kraft paper, which is used primarily for grocery bags and sacks and shipping sacks (multi-wall bags);
- Bleached kraft and relatively minor quantities of bleached and unbleached sulfite packaging papers (primarily glassine and greaseproof papers), which are utilized for a variety of specialty wrapping bag and food carton inner-wrap applications.

The unbleached kraft paper sector is characterized by large-volume production in large-scale mills fully integrated to pulp. Most of the manufacturers produce linerboard and unbleached kraft paper in the same mill since both products use the same type of pulp (primarily unbleached softwood made from southern pine or Douglas fir). Often this dual product mix encompasses one or more "swing machines" which can be shifted back and forth between the heavy grades of sack kraft paper and the lightweight grades of linerboard. Market conditions and prevailing prices for the two products determine the grade mix. Most unbleached kraft paper producers are forward integrated to converting and in aggregate have about a 50% share of the multi-wall bag market and a 75% share of the grocery bag and sack market.

Strength is the most sought-after property in unbleached kraft paper. The essential properties are tearing and bursting strength to fit the product's primary application in bags and sacks.

Bleached kraft and non-kraft packaging papers have much the same applications as unbleached kraft papers, but the end uses are highly fragmented and more specialized. Strength is somewhat less important and visual and printing characteristics much more important than for unbleached kraft.

Nearly all bleached packaging papers are produced in mills integrated for the most part to bleached kraft pulp. The main exceptions are glassine, greaseproof, and vegetable parchment papers — which are used as inner linings for food packages (e.g., dry cereal and cake mixes), specialty bags and a variety of other products. They are produced from various bleached and unbleached softwood sulfite and kraft pulps, often in nonintegrated mills.

FIGURE III-1
UNBLEACHED KRAFT BOARD
FORECAST OF DEMAND AND CAPACITY UTILIZATION

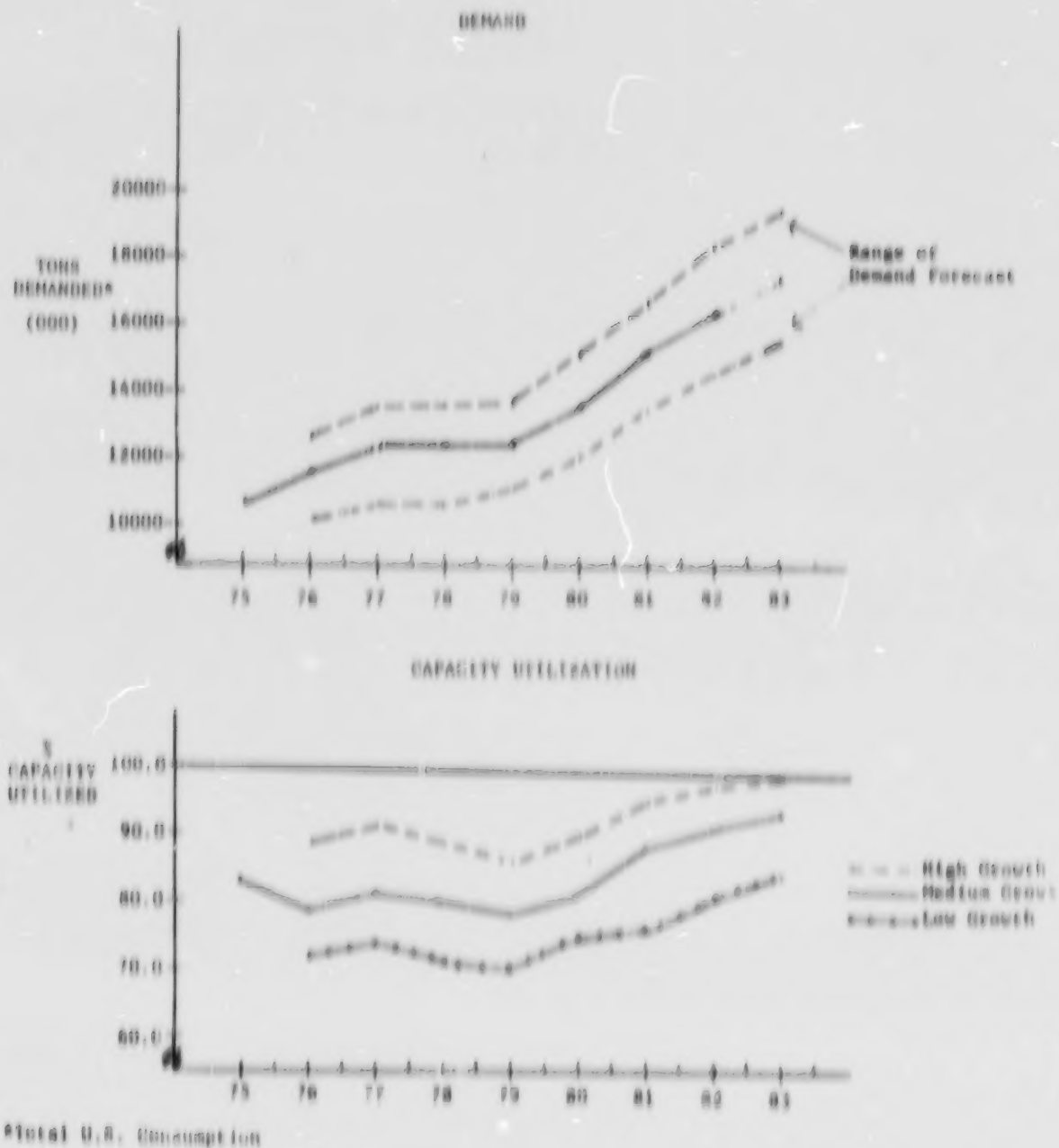
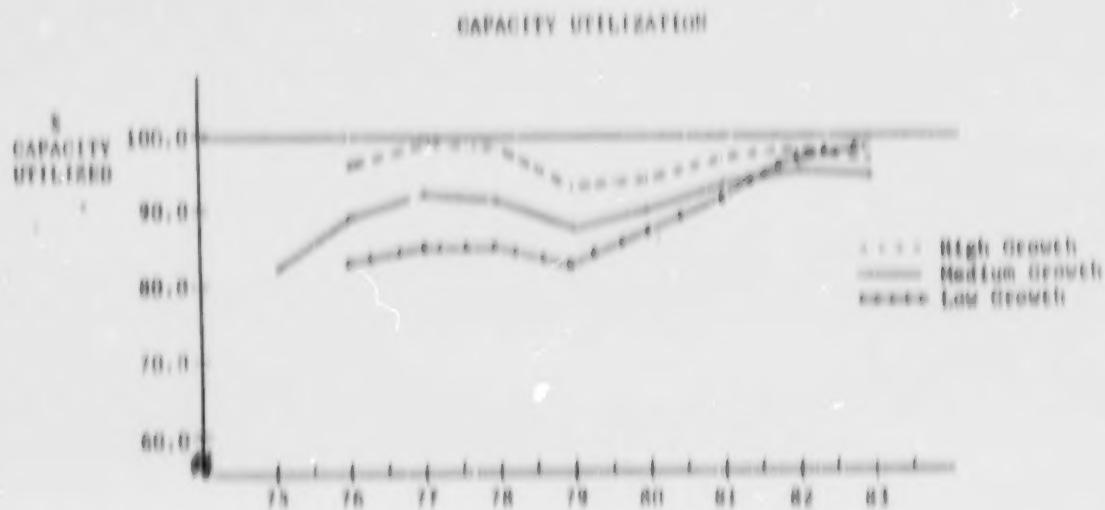
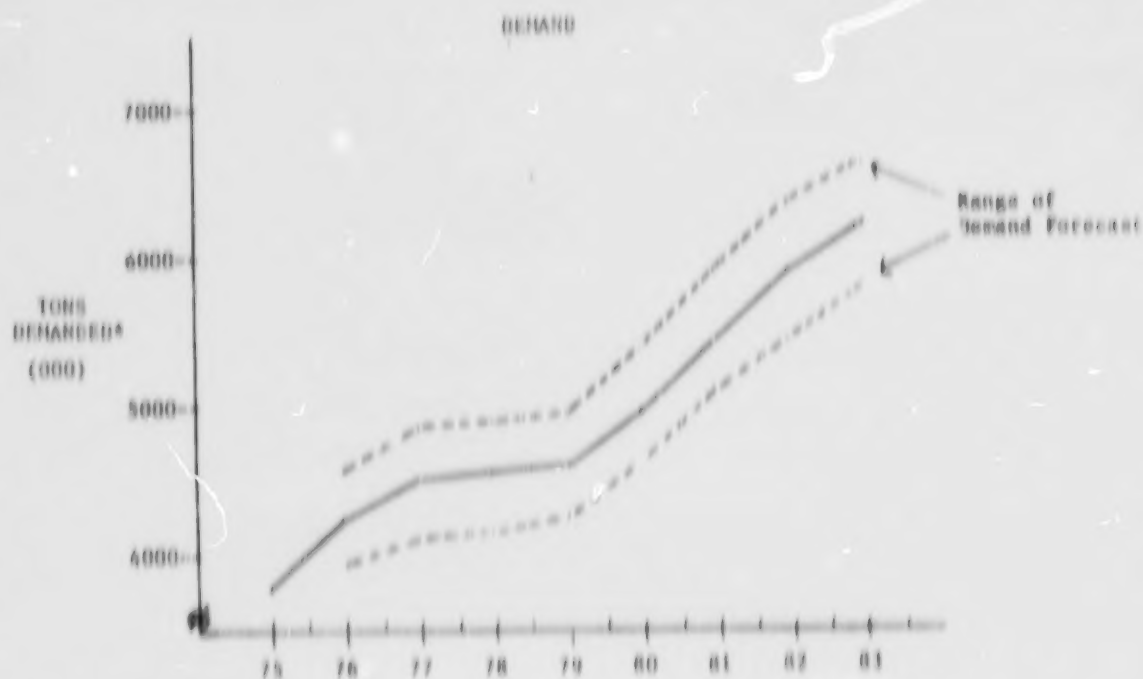


FIGURE III-2
NBS CORRUGATING MEDIUM
FORECAST OF DEMAND AND CAPACITY UTILIZATION



*Total U.S. Consumption

TABLE 111-8

U.S. PACKAGING PAPER SHIPMENTS, 1973 BY MAJOR PRODUCT

	Thousand Tons	%
Unbleached Kraft Papers		
Wrapping	272	5.2
Bag and Sack (Except Shipping Sack)	2,006	38.2
Shipping Sack	1,026	19.6
Other Converting	<u>715</u>	<u>13.6</u>
Subtotal	4,019	76.6
Bleached Packaging Papers		
Wrapping	151	2.9
Bag and Sack (Except Shipping Sack)	254	4.8
Shipping Sack	104	2.0
Other Converting	<u>589</u>	<u>9.3</u>
Subtotal	998	19.0
Glassine, Greaseproof and Vegetable Parchment	<u>230</u>	<u>4.4</u>
TOTAL	5,247	100.0

SOURCE: American Paper Institute, Statistics of Paper and Paperboard, 1973

Econometric analysis was employed only for the larger unbleached kraft component of the packaging papers sector, because it was not possible to obtain an accurate composite of historical bleached packaging paper prices owing to the many grades included in this sector. However, Arthur D. Little believes that the elasticity of demand is somewhat higher and cost pass-through potential somewhat lower than that of unbleached kraft paper.

2. Demand

The growth rate for unbleached kraft and other packaging paper demand is now among the lowest of all the paper industry product sectors. Persistent substitution of plastic film, particularly in the grocery bag and multi-wall bag markets and to a lesser extent in shopping bags, has caused paper demand to remain almost static since 1968. Plastic substitution has been relatively more severe in the bleached kraft and glassine paper sectors, which cost more than unbleached kraft and which must compete to a greater degree with the excellent barrier properties and acceptable graphics of plastic film. From 1964 to 1974, total U.S. consumption of unbleached kraft paper has grown at the rate of 2.7% per year while demand for all other packaging papers has grown at the rate of 1.3% per year.

The Arthur D. Little econometric analysis found that unbleached kraft paper demand correlates most closely with the Gross National Product. This probably reflects the fact that its primary markets are split between consumer markets (grocery bags) and industrial markets (multi-wall bags).

Polyethylene film is the primary substitute product for all packaging papers, particularly those used in grocery and merchandise stores. Its initial penetration was into markets for multi-wall bags (primarily fertilizers and chemicals). Now polyethylene film has become more of a complementary product in these markets; it is used in the inner layer of the multi-wall bag to provide moisture proofing while the paper provides abrasion and impact resistance. Most of the slow growth in multi-wall bags is now accounted for by a trend toward bulk shipment of fertilizers and chemicals. Polypropylene film also is used as a substitute for packaging papers but not nearly to the same extent as polyethylene film.

The substitution of plastic film for packaging papers appears to have abated in 1973 and 1974, primarily because of plastic shortages and rapidly rising prices. Arthur D. Little anticipates, however, that large supplies of plastics and their raw materials will be brought on stream over the next ten years and these will cause supply unbalances that will reactivate the substitution effect on packaging papers.

Almost all packaging papers (of all grades) are distributed direct from the manufacturer to the paper converter. As indicated previously, many of the paper producers are integrated forward to converting, particularly in the case of multi-wall bags and grocery sacks. Integrated bag and sack producers account for over 50% of the production and sales of these products.

The price elasticity of demand for unbleached kraft packaging paper calculated by the econometric methods in this study was 0.9. This was the highest coefficient measured for any pulp and paper sector. The relatively high value is undoubtedly caused by the substitution effect from plastics. Arthur D. Little believes that the price elasticity of bleached packaging paper may be even larger since they are higher priced and thus face greater substitution from plastics.

3. Supply

About 94% of U.S. unbleached kraft paper is produced in mills fully integrated to pulp and usually to timberlands. Surprisingly, in view of the commodity nature of the product, 6% of the production comes from 16 nonintegrated mills, most of which are very small (less than 50 tons per day). Usually these are located adjacent to a pulp supplier.

In view of the competitive pressure from both plastic substitutes and large integrated producers, many of the nonintegrated producers are experiencing a cost/price squeeze and thus have a relatively high closure potential mainly for economic reasons. These mills were not included in Arthur D. Little's closure analysis since the EPA has assigned them to the non-integrated coarse-paper sector where water effluent guidelines have not yet been proposed.

There are 38 integrated unbleached kraft paper mills, of which the seven largest have capacities exceeding 500 tons/day and account for 47% of the integrated capacity. The median mill size is around 300 tons/day. Since 1960, there has been a steady increase in average mill size but little change in the dominance of the integrated mill.

Table III-9 lists the 1974 capacity of the 12 largest producers of unbleached kraft papers. Together they account for 81% of U.S. capacity while the top six firms account for 63%. All are vertically integrated from woodlands to the converting and marketing of grocery, multi-wall and other bags. Thus, this is one of the most highly concentrated as well as most vertically integrated sectors of the paper industry.

In the other packaging papers product sector, the nonintegrated mills — primarily glassine and parchment — have a more significant market share (36%), and the average mill size is far smaller than in the unbleached kraft sector. This pattern has remained essentially the same since 1960; thus, this market is considerably more fragmented in terms of mill size as well as variety of product mix.

Table III-10 shows the capacity shares of producers of packaging papers excluding unbleached kraft. It indicates that this sector is much less concentrated than the unbleached kraft papers sector since few companies place any emphasis on this product line and all suppliers produce these grades as a small part of their total production. In addition, there is a much lower incidence of complete vertical integration from woodlands to converted product.

Most packaging papers are produced in the South, as is the case with other products made in integrated kraft pulp mills. The South accounts for 62% of packaging and industrial converting paper capacity, the West for 16%, the North Central for 12% and the Northeast regions for 11%.

Consistent with the low consumption growth for all packaging papers, capacity is being expanded at a very low rate. The announced capacity expansion commitments between 1973 and 1977 average only 1% per year for unbleached kraft paper and 0.3% per year for other packaging papers.

The extremely low growth in consumption, the threat of continued substitution by plastics and the entrenched position of the major suppliers combine to make entry of new firms difficult if not unfeasible. Because of its slow growth, the market can be supplied readily by incremental expansions of existing mills.

TABLE III-9

CONCENTRATION OF U.S. UNBLEACHED KRAFT PAPERS SUPPLY, 1975

<u>Company</u>	<u>% of U.S. Total</u>	<u>No. of Mills</u>
International Paper	12.7	3
St. Regis	12.4	4
Union Camp	8.3	1
Continental Can	7.6	1
Crown Zellerbach	6.7	5
Gilman Paper	6.2	1
Longview Fiber	6.1	1
Georgia Pacific	4.9	2
Hudson	4.5	1
Top Eight Companies	69.4	
Others (about 20 companies)	30.6	
TOTAL (about 20 companies)	100.0	

SOURCE: Lockwood's Directory of the Paper and Allied Trades, 1975,
Arthur D. Little, Inc.; estimates.

TABLE 111-10

CONCENTRATION OF U.S. PACKAGING PAPER (EXCLUDING WBB)

NAFT) SUPPLIERS, 1973

	% of U.S. Total	Number of Mills
Crown Kellerbach	14.5	6
St. Regis	9.2	3
International Paper	6.1	2
Scott	5.2	2
Riegel	4.9	1
Weyerhaeuser	4.5	2
Brown	4.0	2
Georgia Pacific	4.0	1
Top Eight Companies	52.4	
Others (about 20 companies)	47.6	
TOTAL (about 28 companies)	100.0	

SOURCES: Lockwood's Directory of the Paper and Allied Trades, 1973.
Arthur D. Little, Inc., estimates.

4. Prices

Table III-11 shows the significant price increases achieved by the major unbleached kraft packaging paper grades since January 1973. It indicates that the prices of both the multi-wall and grocery bag grades have risen 81% mostly since March 1974, when price controls were beginning to be lifted for the U.S. pulp and paper industry.

Prices for these grades were relatively stable in the 1960's because of a general condition of excess capacity, intense competition from plastics, and productivity improvements in kraft pulp and paper. However, as the supply/demand balance tightened in 1973, the producers found that they could pass on their cost inflation and improve their profit margins by increasing prices.

Published market price composites are not available for the many grades of bleached packaging papers. Industry contacts, however, indicate that price increases since 1973 have been higher for the bleached and specialty packaging papers, reflecting larger cost increases for bleached pulp products.

TABLE III-11
UNBLEACHED KRAFT PAPER PRICE TRENDS
(Annual Average Contract Prices, \$/Ton)

	Grocery Bag and Sack	Shipping Sack
1971	137	161
1972	158	170
1973	170	184
1974	204	219
1975	240	257

SOURCE: Arthur D. Little, Inc., Industry Survey.

5. Import/Export Balance

There has been continual U.S. trade activity in packaging papers but the tonnages have been small relative to domestic production. Since 1970, unbleached kraft papers exports varied from 100,000-185,000 tons (2.6-4.4% of production) while imports grew to a peak of 120,000 tons in 1973 (3.1% of production).

Both imports and exports of packaging papers, other than unbleached kraft, appear to be rising. In 1973, imports were 90,000 tons (7.3% of production) while exports were 28,000 tons (2.3% of production).

6. Price Impacts

The long-run price increase for unbleached kraft paper will be higher than average (10.1%) as a result of the studied environmental regulations (Table III-12). The existing industry requires a price increase of 5.9%, which is about the industry average, to cover the incremental cost of environmental regulations for existing mills.

7. Output Effects

The price elasticity of demand for unbleached kraft paper is higher than that of any other paper product studied (0.80). As a result, the reduction in quantity demanded due to price increases caused by environmental regulations is higher than in other product sectors. The long-run price increase (10.1%) will reduce demand by 9.1% while the price increase necessary to cover the incremental cost to existing industry (5.9%) will reduce demand by 5.3%.

8. Projected Supply/Demand Balance

Demand for this sector is forecast to grow at an average rate of 2.5% over the period 1976 to 1993 (Figure III-3). Capacity utilization rates are also forecast to be lower than the industry average throughout the period. As a result, there should be no price pressure from tight capacity throughout the 1976-1993 period.

C. RECYCLED PAPERBOARD

1. Product Description

As the name implies, recycled paperboard is manufactured from wastepaper rather than virgin pulp. Generally a variety of commodity wastepaper grades is used, the chief of which are old corrugated containers, waste newspapers, and mixed wastepaper. Occasionally, small amounts of virgin fibers are also added.

Table III-13 shows that recycled paperboard's largest application is boxboard. It dominates the low-cost, commodity end of the boxboard market, but competes strongly with solid bleached board in the high-value end. (See Section B-7, Bleached Board and Bristol.) The boxboard grade is usually pigment-coated or sometimes lined with bleached or deinked pulp to improve its appearance and printing characteristics. A stiffer and heavier grade is used to make set-up boxes for such items as shoes and hardware; this grade is usually fabricated with a paper outer layer to enhance its appearance and printability.

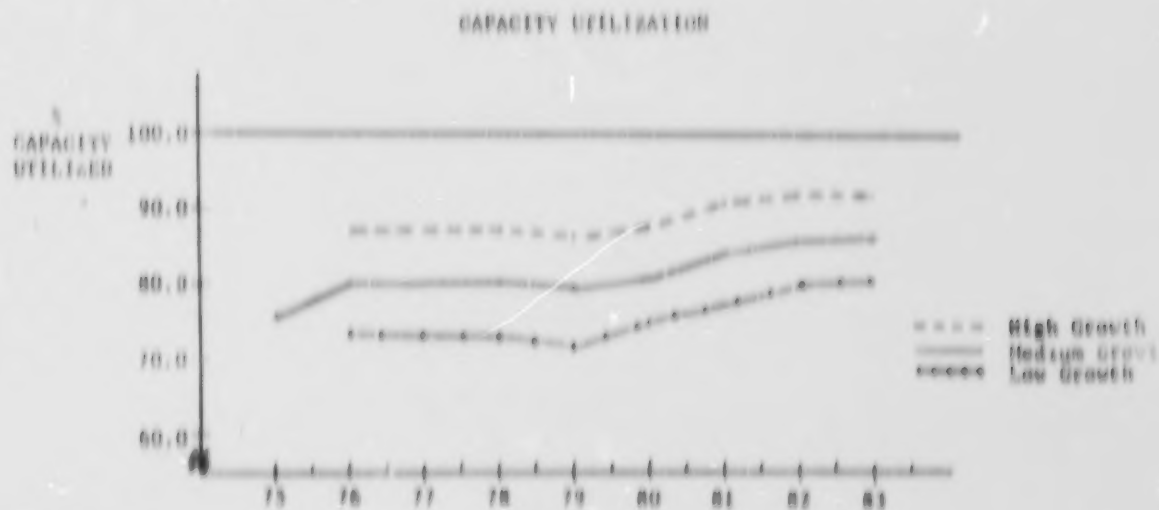
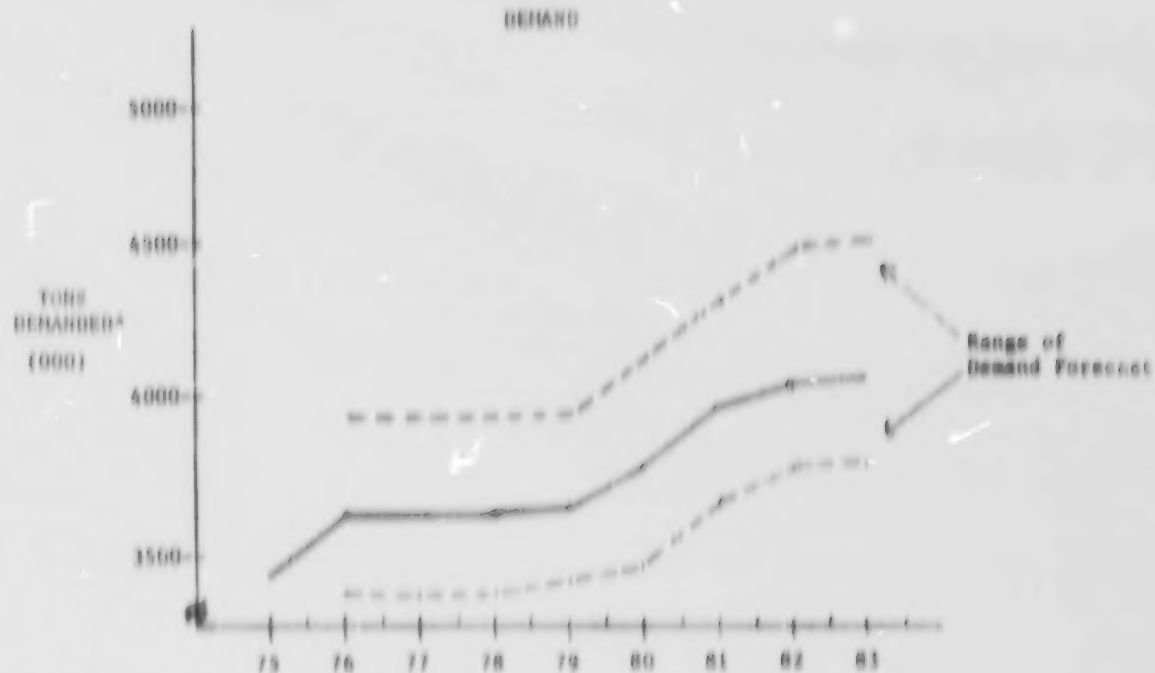
TABLE III-17

EFFECT OF ENVIRONMENTAL REGULATIONS
ON UNBLEACHED KRAFT PAPER PRICES

Environmental Regulation	Existing Industry			Long-Run Price Effect	
	Investment Required \$ Millions	Necessary Price Increase \$/Ton	1985 Price ¹ \$/Ton	\$/Ton	% Baseline Price ²
EPA Water					
1977	122	6.26	2.62	—	—
1983	90	4.97	2.0	—	—
RCRA	—	—	—	21	7.12
Radical Air					
SDS	26	2.50	1.0	—	—
RCRA	—	—	—	3	1.0
SDS Margin	15	.62	.7	6	2.0
Total	\$303	\$14.35	5.92	30	10.12

¹1985 Price 242²Baseline Price 237³Low Capacity Differential 238

FIGURE III-3
UNBLEACHED KRAFT PAPER
FORECAST OF DEMAND AND CAPACITY UTILIZATION



*Total U.S. Consumption

TABLE 111-13

U.S. RECYCLED PAPERBOARD PRODUCTION
BY MAJOR GRADES AND UPER, 1973

	<u>Thousand Tons</u>	<u>%</u>
<u>Boxboard</u>		
Folding	2,522	42.0
Set-Up	665	9.9
Sub Total	3,987	17.9
<u>Containerboard</u>		
Corrugating Medium	1,129	14.3
Linerboard	389	3.7
Chip & Filler Boards	307	3.9
Sub Total	1,725	21.9
<u>All Other</u>		
Gypsum Wallboard Facings	1,050	13.3
Tube, Can & Drum Stock	901	11.4
Exports	31	0.4
Other	1,191	15.1
Sub Total	3,173	40.2
 Total	 7,885	 100.0

SOURCE: API Statistics of Paper and Paperboard, 1975.

Recycled paperboard is much less important in the containerboard market, where it competes with two well entrenched virgin pulp products: NSSC corrugating medium, and unbleached kraft linerboard. (See Section B-1, Containerboard.) The chip and filler board (container liners) component of this market, however, is held almost entirely by recycled paperboard.

The next most important application is gypsum wallboard facings, which is the liner material used to make gypsum wallboard. In this application, recycled paperboard faces no direct competition, but gypsum wallboard competes with a variety of interior wall panelling materials.

Tube, can, and drum stock is a still smaller application. It consists of paperboard that is wound into spiral cans that range from small orange juice cans to large drums for commodities such as chemicals. Unbleached kraft paper and paperboard compete strongly in this market. Recycled paperboard also has a variety of other uses such as cardboard and specialty products; production statistics on these are not reported separately by either the API or the Department of Commerce.

2. Demand

Recycled paperboard draws its demand from a broad cross-section of the U.S. economy. About 70% comes from packaging applications in the form of boxes, corrugated containers, and spiral-wound cans and drums. These packages are used principally in packaging food (primarily dried foods), durable goods and chemical commodities. Recycled paperboard's use in gypsum wallboard facings accounts for 11% of its demand and makes it somewhat sensitive to fluctuations in the construction market. With this fairly broad-based demand, it is not surprising that the macroeconomic variable which correlates most closely with historic recycled paperboard demand is the industrial production index.

Substitution by other paper industry products (greater than in any other product sector) has been a key reason for recycled paperboard's slow growth. Solid bleached board made major penetrations into the folding cartons used in food applications (particularly wet foods) and in high margin nonfood applications such as drugs, cosmetics, and toys. Bleached board displaced recycled paperboard in these applications because the buyers place a premium on cleanliness, aesthetics, or favorable strength/weight relationship. Recycled paperboard still dominates in applications where an inner liner is used (e.g., cereals or crackers) and where low cost is a key criterion for the carton stock (e.g., in soap, detergents, and paper goods).

Recycled paperboard was the original linerboard material in corrugated containers, but now it has been displaced almost completely by unbleached kraft linerboard. This displacement might slow or even stop, in light of kraft linerboard's slow capacity expansion, which foreshadows large future price increases. Corrugating medium has been one of recycled paperboard's fastest growing markets, but even here the competing NSSC corrugating medium has enjoyed a more rapid growth and increased market share. Little substitution is occurring in chip and filler board. However, container users are learning to use less of this material by doing without partitioning and by using the packaged products to contribute to the structural support of the container.

Gypsum wallboard (which is made exclusively with a recycled paperboard liner material) is a well entrenched construction product used for both new construction and remodeling. As a result, its demand does not fluctuate as sharply as the building cycle. It does face substitution by other wall panelling materials, but this has been relatively minor thus far.

Plastics have not had an important substitution impact in the major markets for recycled paperboard. However, plastics are often used in conjunction with recycled paperboard in blister or bubble packaging of products such as toys and hardware parts which are mounted on a printed piece of paperboard. This approach effectively reduces the paperboard required to package the product. The net result of displacement by competing products plus the relatively slow growth of its major markets is that total demand for recycled paperboard has not grown since the early 1960's. Its annual rate of growth as averaged -0.6% from 1964 to 1974 and 0.8% from 1969 to 1974. The price elasticity of demand measured in the Arthur D. Little econometric analysis was 0.46, which is close to the average for all pulp and paper products.

3. Supply

In 1974, U.S. capacity for recycled paperboard stood at 8.7 million tons. Regionally, this capacity is distributed fairly evenly in proportion to the country's population distribution. This reflects the fact that wastepaper, the principal raw material, is most economically obtained from the major metropolitan areas.

Table III-14 shows that recycled paperboard is one of the least concentrated sectors in the paper industry. The top 10 companies account for just over 50% of total U.S. capacity, but more than 100 companies have significant capacity in this product line. Note, however, that there is considerable product specialization particularly in boxboard, containerboard, and gypsum wallboard facings.

Vertical integration is most pronounced in gypsum wallboard facings followed by boxboard and containerboard. All gypsum wallboard producers make their own wallboard facings; there is only one significant independent supplier of this material. About 50% of the folding boxboard capacity is forward integrated to folding carton production. There is also substantial forward integration by the recycled corrugating medium producers. Many of the smaller corrugated container converters have integrated backward to recycled corrugating medium, since this was their least-cost method of integrating back to one of their major raw materials.

4. Prices

Recycled paperboard prices, as did prices of most paper and paperboard products, moved strongly upward after the 1970 recession, and especially after price controls were removed in mid-1974 (Table III-15). Between 1971 and 1975, clay coated boxboard registered the largest gain (88%) in this sector, followed by corrugating medium (71%), gypsum linerboard (68%), and container chip and filler (63%). Prior to 1971, these product prices were essentially stable in current dollars but declined in constant dollars.

Gypsum linerboard was the only product whose contract price declined during the 1975 recession. However, this may be misleading since the major wallboard producers are all vertically integrated, leaving a very thin market for arm's-length sales. Prices of the other major grades of recycled paperboard held up throughout 1975, reflecting the general pattern of price stability for the rest of the paper industry.

TABLE III-14

CONCENTRATION OF U.S. RECYCLED PAPERBOARD SUPPLIERS, 1975

Company	% of U.S. Total	Ranking of Firms
CCA	6.9	10
Whippany	6.9	5
Bonaca	5.4	10
U.S. Gypsum	4.1	7
PCA	4.1	5
Federal Paperboard	3.9	8
National Gypsum	3.6	5
Newark Boxboard	3.3	9
Top Eight Companies	38.2	
Others (about 93 companies)	61.8	
TOTAL (about 101 companies)	100.0	

SOURCES: Lockwood's Directory of the Paper and Allied Trades, 1975.
Arthur D. Little, Inc., estimates.

5. Import/Export Balance

Wastepaper is plentiful and cheap in most of the world's industrialized regions. This factor, coupled with widespread imposition of import duties to protect domestic recycled paperboard industries, effectively keeps imports and exports to a minimum. In 1973, U.S. imports of recycled paperboard were 27,000 tons (0.4% of consumption), and exports were 307,000 tons (2.6% of production). Most of the exports were to South America and Japan where the wastepaper supplies are relatively tight.

6. Price Effects

Table III-16 shows the price impacts, investment and annualized cost for recycled paperboard mills compliance with the studied environmental controls. The price effects for this sector are low to moderate, with a long-run price impact of 5.8% compared to 7.8% for the industry aggregate. The existing industry must have a 4.0% price increase to cover incremental compliance costs. As expected, the 1977 water regulations and NSPS water regulations will account for the major portion (75%) of the projected total price increase. This sector is not required to meet any New Source Performance Standards for air quality. SIP air control costs are required for both new sources and existing mills for power boiler emissions. However, SIP costs account for only 30% of the sector's environmental cost increases through 1983.

TABLE III-15
RECYCLED PAPERBOARD PRICE TREND

(Annual Average Contract Prices \$/Ton)

	1971	1972	1973	1974	1975
Clay Coated Boxboard	144	150	180	260	270
Gypsum Linerboard	94	97	111	168	158
Recycled Corrugating Medium	108	111	130	164	185
Container Chip and Filler	115	120	140	185	188

SOURCE: Arthur D. Little, Inc., Industry Survey.

The effect of the projected price increases on consumer prices is likely to be small. Most recycled paperboard is made into boxes used to package relatively high-value products. Average paperboard values run 2-5% of the cost of the packaged product. Therefore, the environmentally related paperboard price increases (4-6%) would increase packaged product prices only 0.1-0.3%.

7. Output Effects

Price increases from environmental regulations will reduce demand 1 1/2-2.4%. Long-run price increases required will reduce demand at the higher end of this range.

8. Projected Supply/Demand Balance

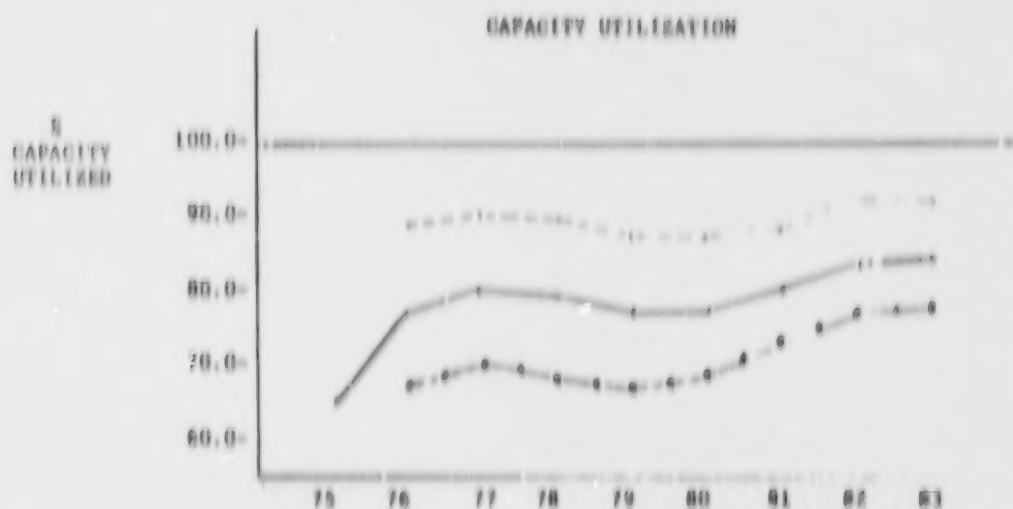
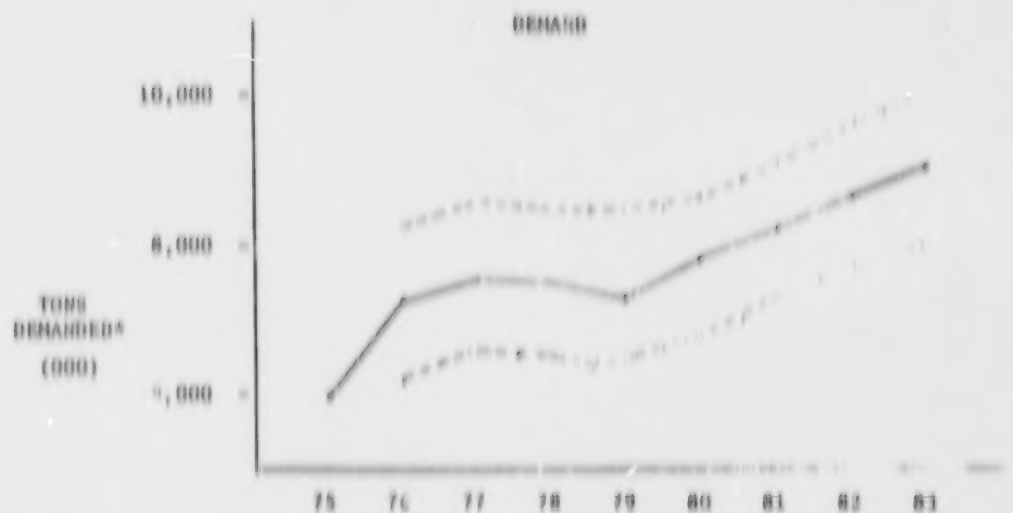
Estimated mill closures or slower rates of capacity expansion resulting from water pollution regulations will not create a tight supply situation through 1985, because the forecast capacity utilization rate does not exceed 80% throughout the period (Figure III-4). This conclusion does not change at the upper and lower bounds of the demand and capacity projections.

TABLE 10-18
EFFECT OF ENVIRONMENTAL REGULATIONS ON RECYCLED RESOURCE PRICES

Environmental Regulation	Energy Industry			Recycled Resource			Average Prices, \$/ton		
	Investment Required (\$ millions)	Price Increase (\$/ton) 1973-1975	Price Increase (\$/ton) 1975-1980	Recycled Resource (\$/ton) 1973-1975	Recycled Resource (\$/ton) 1975-1980	Recycled Resource (\$/ton) 1980-1985	1973-1975	1975-1980	1980-1985
SO ₂ Abate									
1977	1287	81.00	2.40	-	-	-	-	-	-
1982	54	1.60	0.7	-	-	-	-	-	-
1985	-	-	-	522	4.6	522	1.00	522	6.90
Federal Air									
1975	34	1.00	0.6	1	0.4	1	0.5	1	0.5
1985	-	-	-	-	-	-	-	-	-
1980 Abate	51	1.20	-	2	0.8	2	0.9	2	1.1
Total	1335	83.60	4.00	523	1.0	526	1.5	528	9.50
1975 Prices				522		528		528	
1980 Prices				526		529		529	
1985 Prices				-		532		532	

SOURCE: Richard A. Linn, "The Environmental Impact of Energy Regulation," in "Energy and the Environment," p. 100.

FIGURE III-4
RECYCLED PAPERBOARD
FORECAST OF DEMAND AND CAPACITY UTILIZATION



*Total U.S. Consumption

High growth
Medium growth
Low growth

B. CONSTRUCTION PAPER

1. Product Description

Construction paper is a component of SIC 2661 (Building Paper and Building Board Mills). The Department of Commerce also includes hardboard and insulation board in this industry subcategory, but for effluent guideline purposes, the EPA has considered the latter products under the wood products industry because of their relatively low effluent loadings and close market relationship with wood products.

Construction paper comprises sheathing papers, felts (roofing, floor covering, automotive sound deadening, industrial, pipe covering and refrigerator), asbestos and asbestos-filled paper, and flexible wood fiber installation. Except for asbestos paper, these materials are usually made primarily from wastepaper. Almost all forms of construction paper are converted at the mill site to the end product, e.g., shingles, which is then sold to the construction trade.

Gypsum linerboard, the facing material for gypsum wallboard, is included in the recycled paperboard sector, since it is a paperboard product made entirely from wastepaper. The only other significant paper-based products employed in construction are overlay and print sheets used for decorative wall panels; these papers are included in the specialty paper sector.

2. Demand

Like all building materials, the demand for construction paper subdivides into new construction and replacement (or remodeling) components. The replacement market is a large component because roofing shingles, which require relatively frequent replacement, are the largest end use. Also, floor underlayment and sheathing papers are required for many remodeling projects. Thus, the construction paper market does not experience as severe year-to-year fluctuations in demand as do most other commodity construction materials. Construction paper demand grew at a fairly steady average rate of 1.8% per year between 1964 and 1974, with only a modest drop in consumption during the construction industry recession in 1973 and 1974.

There are no significant direct product substitutes for construction paper. However, shifts in other construction materials use, such as the substitution of wooden floors by vinyl tile and wall-to-wall carpeting, have reduced the consumption of underlayment paper.

Almost all construction paper is transferred internally since it is typically consumed captively by manufacturers of building material end products. The final product is then distributed by regular construction industry wholesale and retail channels.

3. Supply

Table III-17 shows that the capacity distribution of the major construction paper producers is highly concentrated among five companies. Like all of the construction paper producers, the top five are integrated forward to the conversion of final products. This market share advantage generally stems from a national network of mills coupled with multi-product distribution to the construction industry.

Construction paper mills are generally near major metropolitan areas, which produce both their source of wastepaper raw materials and their major markets. Furthermore, most of these mills have access to municipal effluent treatment systems, which allows them to avoid spending

TABLE U1-17

CONCENTRATION OF U.S. CONSTRUCTION PAPER SUPPLIERS, 1975

<u>Company</u>	<u>% of U.S. Total</u>	<u>Number of Mills</u>
GAF	17.6	8
Celotex	15.4	10
Lloyd Fry Roofing	14.7	13
Certain - Teed	10.0	7
Bird & Son	9.2	4
Johns - Manville	5.1	3
Flintkote	4.4	2
Congoleum	<u>4.1</u>	1
Top Eight Companies	81.0	
Others (about 15 companies)	<u>19.0</u>	
TOTAL (about 23 companies)	100.0	

SOURCE: Lockwood's Directory of the Paper and Allied Trades, 1975.
Arthur D. Little, Inc., estimates.

capital for their own inefficient-sized water treatment plants. Not surprisingly, therefore, construction paper production is roughly proportional to the country's population distribution with 34% in the North Central region, 29% in the South, 26% in the Northeast and 10% in the West.

Since vertical integration from paper to conversion and wholesale distribution is the dominant company structure, it also would be highly risky for an independent supplier of paper alone to enter. Given the product's growth rate of 1-2% per year, most future capacity expansion is likely to come from incremental expansion of existing mills.

Costs for incremental additions or even for new mills are relatively low by paper industry standards so the required investment does not pose a difficult entry barrier. Nor does fiber resource control pose a significant barrier at this time since the required wastepaper raw material is still plentiful near most metropolitan areas.

4. Prices

Most construction paper is, as previously mentioned, captively produced by the manufacture of the final product. Therefore, it is difficult to develop an accurate historical trend in selling prices for the paper. Although the retail prices of the final products can be ascertained, they do not necessarily reflect trends in the cost of the intermediate materials. The difficulty of compiling an accurate historical trend for construction paper prices was the principal reason for omitting an econometric analysis for this sector.

In view of the vertically-integrated and oligopolistic characteristics of the construction paper market, the product's value or transfer price of the paper probably has been more stable than that of most other paper industry products. Therefore, its price probably increased less than that of the average paper industry product between 1971 and 1975.

5. Import/Export Balance

Construction paper imports and exports traditionally have been relatively small. In 1974, a peak year, imports were 60,000 tons (3% of consumption), while exports were 20,000 tons (1.4% of production). Standardized production techniques and use of a wastepaper furnish tends to eliminate any relative cost/quality advantages for both importers and exporters. There is no reason to expect if this pattern of minimal trade will change through 1983.

6. Price Impacts

Long-run price impacts were not estimated for construction paper nor was an econometric supply/demand model employed. The price increase necessary for the existing industry to recover the incremental cost of the studied environmental regulations was estimated at 3.7%; the breakdown of this price is shown in Table II, 18. The necessary price increase is less than the industry average, principally because most mills use municipal treatment systems.

E. MARKET PULP

1. Product Description

Market pulp (i.e., pulp that is sold rather than used internally by the producer) consists primarily of dissolving pulp and bleached paper pulps both of which are made from the sulfite and kraft processes. Market sales of the unbleached chemical pulps, groundwood pulp, and

TABLE 111-10

EFFECT OF ENVIRONMENTAL REGULATIONS ON CONSTRUCTION PAPER PRICES

<u>Env. Control Regulation</u>	<u>Existing Industry</u>		<u>Necessary Price Increase X 1975 Price¹</u>
	<u>Investment Required</u>		
	<u>\$ Millions</u>	<u>\$/Ton</u>	
<u>EPA Water</u>			
1977	534	3.50	1.48
1983	24	2.51	1.0
NSPS	—	—	—
<u>Federal Air</u>			
HAPs	9	.91	.04
NSPS	—	—	—
<u>OSHA Noise</u>			
	23	2.21	.09
Total	590	\$9.04	1.78

¹1975 Price = \$246

SOURCE: Arthur D. Little, Inc., estimates.

deinked wastepaper are relatively small. Dissolving and special alpha pulps consist of highly refined bleached pulps with a high content of alpha or pure cellulose fibers. These pulps are used primarily as the raw material for rayon and acetate fibers, cellophane, and a variety of cellulose chemicals and specialty papers. Both dissolving and paper pulps are freely traded throughout the world; thus, the U.S. market is highly sensitive to world market conditions.

The chief quality characteristics looked for in dissolving pulp are that it be extremely free from dirt and other impurities and have an alpha cellulose content appropriate for the end use applications. Thus, different grades are supplied for acetate, rayon, cellophane, specialty papers, and cellulose chemicals. Quality consistency is extremely important; thus, a long period of product testing is normally required before a customer will shift to a new dissolving pulp supplier.

The bleached and semibleached grades of kraft and sulfite pulp currently constitute about 80% of the total pulp purchased by U.S. mills that are not integrated or only partially integrated to on-site pulp production. The primary products produced by such mills are printing and writing papers, sanitary tissue and related papers, mainly of a specialty nature. Part of the supply of bleached papermaking pulps is produced by dissolving pulp mills, all but two of which, in the United States, currently produce both dissolving and paper grade pulps. The paper grade pulp mills, however, are not able to produce dissolving pulp without substantial reinvestment.

The chief function of the paper grade pulps is to provide a white surface and sufficient strength to make the product usable. In both printing and tissue papers, a blend of hardwood and softwood pulps is used, sometimes in conjunction with groundwood pulp, to provide the desired properties of surface smoothness, opacity, softness, and strength. The short hardwood fibers are used to provide a smooth printing surface and opacity while the long fiber softwood pulps are used to provide most of the required strength. Distinctions are also made between the coarse fiber softwood pulps derived from southern pine and Douglas fir and the generally more highly sought after softwood pulp derived from northern spruce. Generally a premium price is paid for the northern pulp except when the supply/demand balance is extremely tight. Southern hardwood pulp also has a somewhat lower utility than northern hardwood pulp in the eyes of many customers because it often contains a larger proportion of oak fibers, which cause problems in papermaking.

2. Demand

• Dissolving Pulp

Table III-19 shows estimates of 1973 world dissolving pulp consumption (excluding Communist countries). This indicates the dominant share of demand held by rayon and acetate fibers. These fibers accounted for about 70% of consumption in 1973. The remaining 30% was made up of a variety of relatively small applications. Because there are few producers of rayon and acetate fibers, cellophane and cellulosic fibers and also relatively few suppliers of dissolving pulp, this market probably comes closest to being a bilateral oligopoly of any pulp and paper industry sector.

From 1960 through 1973, U.S. consumption of dissolving pulp grew at an apparent average rate of 1% per year. However, examination of the trend shows that U.S. consumption peaked in 1968 and by 1973 had declined by a total of 13%. World demand appears to have peaked in 1970 but is declining at a slower rate than U.S. demand. Thus, dissolving pulp represents a product that appears to have reached its maturity and is now declining.

The primary reasons for this trend are the static total demand for rayon and declining demand for acetate fibers and cellophane, while other dissolving pulp applications are growing only slowly. Rayon and acetate fibers are facing intense competition, particularly from polyester fibers, and cellophane is being replaced by plastic packaging films. However, there are no direct substitutes to displace dissolving pulp itself in any of its major applications. The econometric analysis in this study calculated a low price elasticity of demand of 0.49 in the United States market.

TABLE III-19

FREE WORLD DISSOLVED PULP DEMAND BY MAJOR APPLICATION, 1973

Application	Dissolving Pulp Used (000 metric tons)	% of Total
Rayon		
Staple and Tow	1,750	65.1
Regular & H.T. Filament	990	16.8
SUBTOTAL	2,740	59.9
Acetate and Triacetate		
Filament, Staple & Tow	380	9.6
Cellophane	910	12.8
Special Industrial Papers	380	9.6
Cellulosic Chemicals, etc.	360	9.1
TOTAL	3,970	100.0

SOURCE: Arthur D. Little, Inc.; estimated.

• Bleached Market Pulp

Table III-20 shows estimates of the approximate U.S. end-use subdivision for bleached market pulp in 1973. It indicates the importance of the printing/writing paper and tissue paper markets, which together constitute about 80% of the demand. In 1973, bleached market pulp amounted to 21% of the total bleached pulp consumed in the United States, the balance being consumed by integrated mills.

TABLE 111-20

U.S. CONSUMPTION OF BLEACHED MARKET PULP, 1973

Application	Consumption	
	Thousand Tons	Percent of Total
Printing/Writing Papers	2,000	51
Tissue	1,200	31
Other Paper Products	300	8
Fluffing Pulp	400	10
	3,900	100

SOURCE: Arthur D. Little, Inc., estimates.

The total U.S. consumption of bleached market pulp has grown at a very steady rate of nearly 6% per year since 1960 with only a slight reduction in the growth rate during the five years prior to 1973. Underlying this trend were: 1) the demand for printing/writing and tissue papers, which grew faster than the industry average, and 2) the low and stable pulp prices, which permitted nonintegrated producers to maintain their cost competitiveness.

Since 1968, there has been a modest tapering off of the growth rate in printing/writing paper (more pronounced in tissue paper), but this has been compensated for in part by the extremely rapid growth in fluffing pulp, which is used for disposable diapers and bed pads. Thus, bleached market pulp is still one of the fastest growing areas in the pulp and paper industry. However, the tight supply of bleached pulp and the extremely rapid price increases in 1973 and 1974 created a cost squeeze for the nonintegrated mills which still persisted through 1976, causing them to lose market share. This development could well cause slower growth in market pulp demand. However, the econometric analysis in this study indicates that the historic price is relatively inelastic.

No other materials offer any significant direct competitive threat to bleached paper pulp. Pulp substitute materials derived from plastics have been developed but these are several times more expensive than wood pulp even at the new pulp price levels. The synthetic wood pulps are being experimented with as blending pulps primarily to provide high-strength properties in specialty applications which either require high-strength, water resistance, or a combination of both.

While total demand for bleached market pulp has grown at a fairly steady rate, there has been a dramatic shift in consumption from the sulfite to the kraft grades. Between 1960 and 1973, for example, sales of bleached sulfite pulp dropped in half while that of the bleached and semibleached kraft grades tripled. This shift has been caused mainly by the fact that bleached sulfite pulp capacity has remained static (as a result of pollution-related closures and few expansions) and increasing amounts have been diverted to captive use. Thus, the rapid shift does not represent an overwhelming preference for kraft pulp.

The softwood grade of kraft pulp offers superior strength properties in comparison with softwood sulfite. In balanced supply/demand markets, a price discount of \$5-15/ton for sulfite pulp reflects this disadvantage. However, sulfite does offer superior softness and somewhat better opacity and thus is still desirable in certain tissue paper and writing paper grades. Hardwood kraft pulp comes close to sulfite's strength and opacity properties, but sells at a lower price. Still sulfite's main difficulty appears to be the uncertainty of how long its supply will be maintained in light of current state and Federal water effluent regulations.

3. Supply

Canada is the main source of supply for bleached market pulp consumed in the United States. Canadian imports account for 88% of the bleached market paper pulp consumed in the United States. However, it supplies only about 12% of the dissolving pulp consumed in the United States.

Because their locations are relatively remote and because pulp can be exported duty free while most paper products cannot, most of the Canadian pulp mills specialize in market pulp rather than integrating to on-site paper production. From 1960 through 1972, Canadian pulp producers expanded their capacity very rapidly and operated well below capacity while providing increasing amounts of pulp to the U.S. and other world markets. In 1973 and 1974, however, the Canadians operated near full capacity except during mill and railroad strikes. Canadian expansion commitments indicate that capacity will increase more slowly through 1980.

The U.S. domestic supply of bleached market pulp comes from two sources. One is the mills that specialize in producing market pulp; these, however, produce primarily dissolving pulp and thus, have only a small share of the paper pulp market. The largest portion of the bleached market pulp supply comes from mills that are integrated to paper and paperboard. Often, during an expansion program, the pulp mill is built larger than the paper or paperboard mill to take advantage of economies of scale; the company then sells market pulp until it expands its paper mill to equal the pulp mill capacity. Thus, there is a continual shifting in and out of the bleached paper pulp market as companies become more or less integrated to pulp.

The problem of changing degrees of forward integration is not present with dissolving pulp in that all the North American mills are dedicated to this product or to a combination of this

product and bleached paper pulp. However, one U.S. dissolving pulp mill is partially owned by companies that produce rayon fiber and thus is integrated forward to rayon operations not located at the pulp mill.

Table III-21 shows the shares of North American capacity for dissolving pulp and bleached paper grade pulp held by the major producers. It indicates that the dissolving pulp capacity is especially concentrated. Bleached paper grade pulp is not dominated by one producer as is dissolving pulp with the top four firms accounting for 99% of the market.

4. Prices

The substantial world trade in bleached papermaking pulps causes prices for these commodities to follow changes in the total world ratio between production and capacity more closely than the operating ratio within a given country. Moreover, pulp prices tend to lead rather than follow paper prices. Historically, when the ratio of total world production to total capacity moves up to around 99%, as it did in 1974, market pulp prices rise strongly and suppliers' profit margins increase. When world demand falls to 90-99% of world supply, profit margins tend to stabilize. (That is, prices increase only if costs of the most efficient suppliers increase.) Finally, when world operating rates drop below 90%, margins, and often prices, tend to erode.

The econometric analysis in this study found reasonably good correlations between U.S. bleached pulp supply/demand relationships and price and employed this data because it was more current and available in more detail than world data. Figure III-5 plots these U.S. capacity utilization and price data since 1965.

Dissolving pulp prices are much less sensitive to changes in capacity utilization and have fluctuated more gradually than paper pulp prices. With relatively few buyers and sellers, purchase contracts traditionally have included price protection clauses and are of longer duration than the typical paper grade pulp contract. This price change smoothing and muted response is demonstrated in Figure III-6, which plots U.S. capacity utilization versus price since 1965.

Paper grade pulp prices dropped to about their lowest levels of the last decade in 1971, when world average pulp mill operating rates were around 80% of capacity and North America, Europe and Japan were in a business recession. There were modest price increases of \$5-15 per short ton in 1972, as the economy and operating rates began to improve. Then in 1973 and 1974, prices increased at unprecedented rates as operating rates reached maximum levels. In North America, for example, average contract prices for bleached softwood kraft pulp increased 100% (by \$100/ton) between the third quarters of 1973 and 1974, and those for bleached hardwood kraft pulp, 165% (by \$200/ton). Dissolving pulp prices rose about 87% from 1972 to January 1975 starting from a higher base of about \$220/ton. Spot prices for relatively small orders throughout the world were considerably above contract prices in 1973 and 1974 but these differentials were removed as the market weakened in the second half of 1974. These increases allowed the producers to cover the accumulated cost inflation they had been unable to pass on in weak markets or under price controls, and brought their 1974 profits to a record high level.

The lack of price responsiveness to changes in historical operating rates was caused primarily by two factors. First, in the 1960's the producers were able to hold their costs down because inflation rates were low and they were able to improve productivity steadily by enlarging and modernizing their mills. Second, the Canadian bleached pulp industry was expanding its capacity at about 20%/year and this influx kept prices low despite fluctuations in U.S. operating rates.

TABLE III-21
CONCENTRATION OF NORTH AMERICAN MARKET PULP SUPPLY, 1975

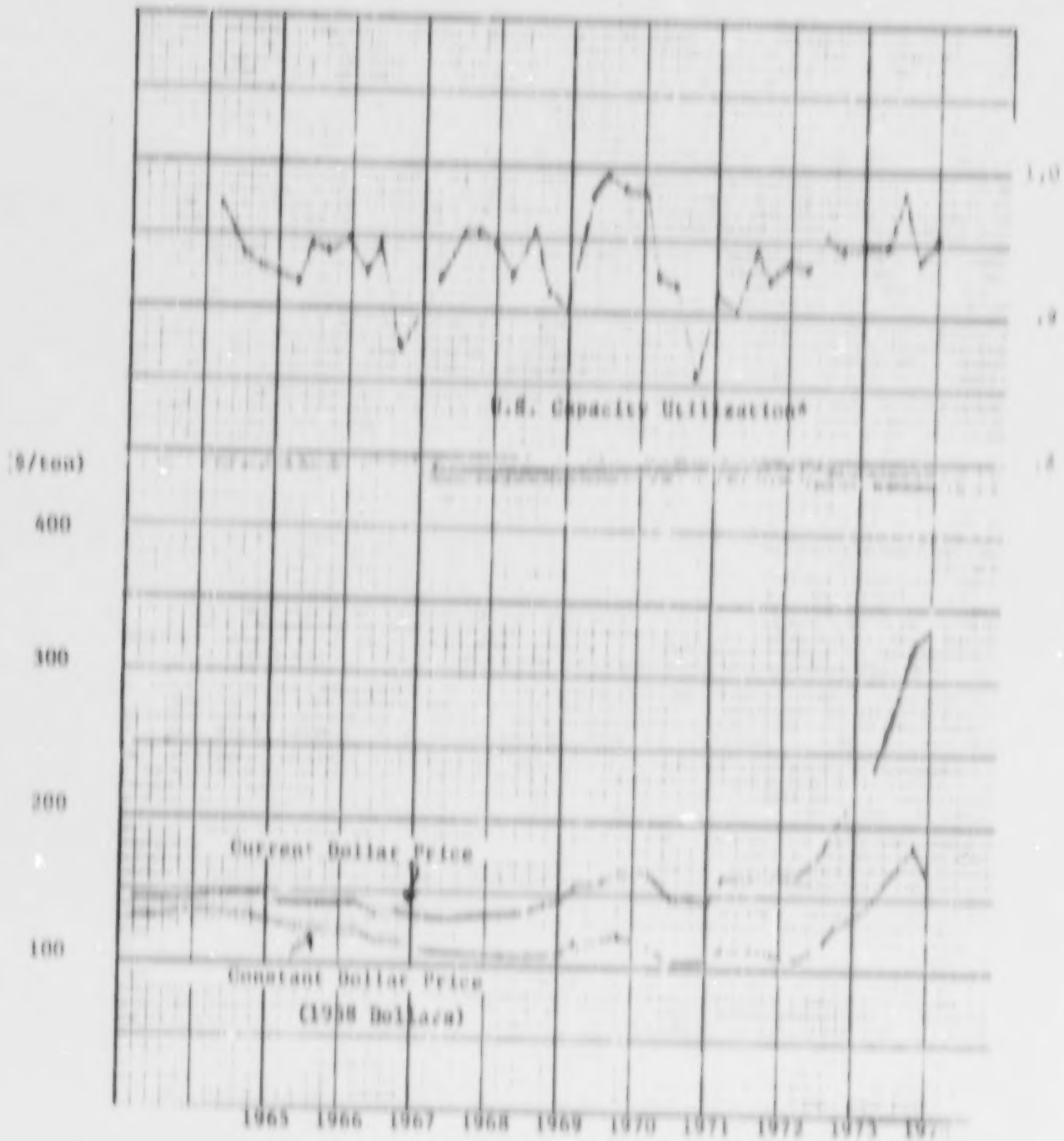
<u>Company</u>	<u>% of Total North America</u>		<u>Number of Mills</u>
	<u>Dissolving Pulp</u>	<u>Bleached Paper Pulp</u>	
ITT Rayonier	44	4.3	7
International Paper	14	5.9	6
Procter & Gamble	10	(not in top 8)	1
Ketchikan Pulp	9	"	1
Alaska Lumber	9	"	1
Canadian Cellulose	8 ¹	6.7	2
Meyerhaeuser	4	11.3	3
Tembec Forest Products	<u>2</u>	(not in top 8)	1
Total (Dissolving Pulp)	100		
Parsons & Whittamore		7.0	2
B. C. Forest Products		5.7	2
MacMillan Bloedel		5.3	1
Georgia Pacific		<u>4.3</u>	3
Top Eight Companies		50.5	
Other Suppliers (about 17 companies)		<u>49.5</u>	
TOTAL (Paper Pulp)		100.0	

¹ Mill closed September 1977.

SOURCE: Lockwood's Directory of the Paper and Allied Trades,
Arthur D. Little, Inc.; estimates.

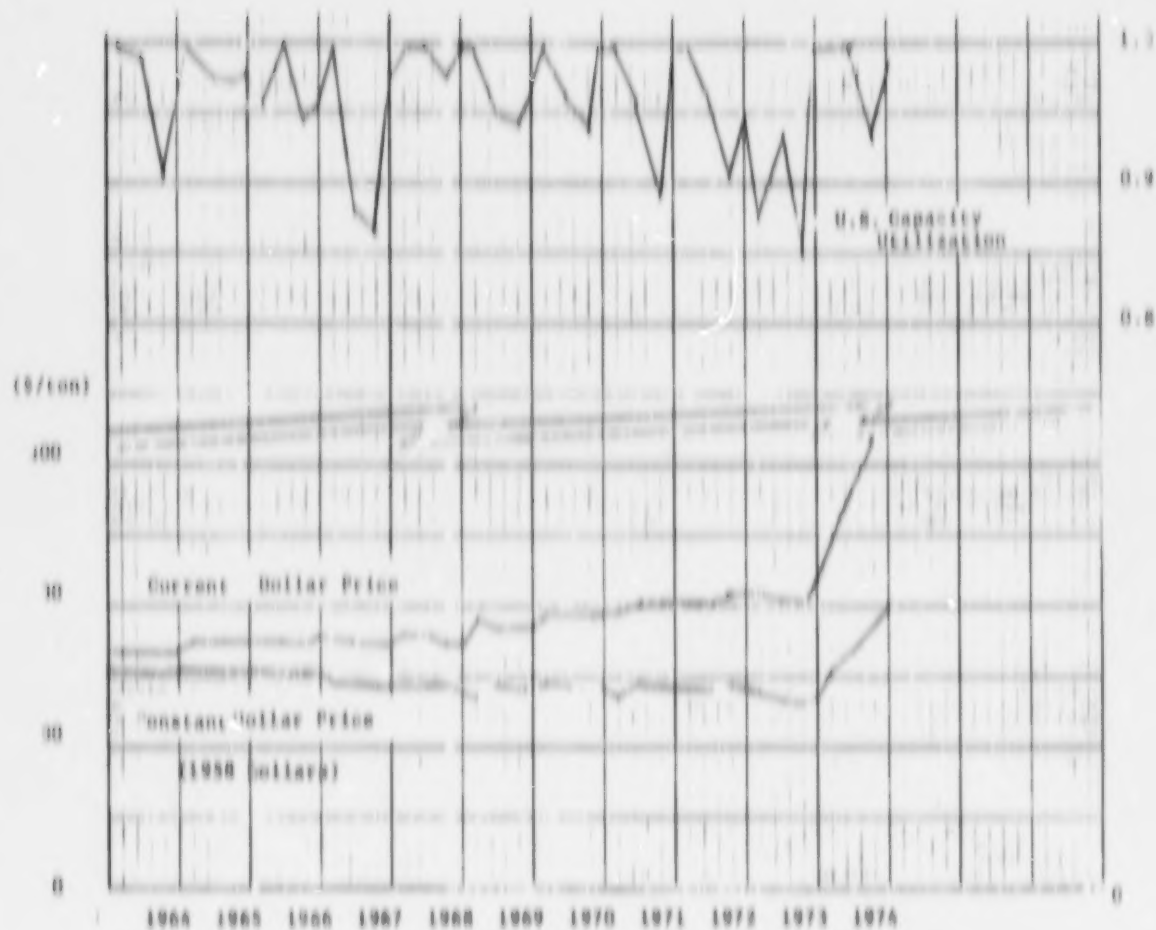
FIGURE 111-5

BLEACHED PAPER PULP MARKET PRICE
VERSUS CAPACITY UTILIZATION



^aCapacity Utilization calculated from Total Bleached Sulfite and Kraft Production and Capacity.

FIGURE III-8
 DISSOLVING PULP MARKET PRICE
 VERSUS U.S. CAPACITY UTILIZATION



5. Import/Export Balance

The United States is a net exporter of dissolving pulps and a net importer of bleached paper grade pulps. In 1974, the United States imported 236,000 tons and exported 788,900 tons of dissolving pulp. In that same year, it imported 3.1 million tons and exported 1.8 million tons of bleached paper grade pulp. Bleached paper pulp thus ranks second to newsprint in import volume and second to kraft linerboard in export volume.

The trend in exports has been down from a high point reached in 1970. Imports have increased modestly from a previous high in 1969. Tariffs are seldom levied on pulp, thus facilitating large-scale international trade.

The U.S. pulp export position has been based largely upon its comparatively low-cost pulpwood and large mills. On the other hand, Canadian wood costs, on average, have been higher than those of southern U.S. mills, but they have equally large mills with greater specialization in the market pulp; this accounts for their large export volume to the United States. Thus, nearly all of the pulp imports come from Canada, the world's largest producer of market pulp. U.S. exports are largely to Western Europe, South America, and Japan.

6. Price Impacts

As mentioned previously, the demand for dissolving pulp is gradually declining. As a result, no new dissolving pulp mills will be built in the United States. The ability of existing mills to recover the incremental costs of compliance with the studied regulations will depend upon market conditions. The existing industry requires a 6.6% price increase to recover environmental costs (Table III-22).

Few new mills will be built that are not integrated back to bleached paper pulp. The long-run price effects for the consuming product sectors (primarily printing/writing paper and tissue) incorporate the costs of environmental regulations on bleached pulp.

7. Output Effects

The price elasticity of demand estimated for dissolving pulp is 0.65. If existing mills are able to increase prices by the 6.6% necessary to recover incremental control costs, demand will decline by 4.1%.

8. Supply/Demand Balance

The dissolving pulp sector is not growing. Capacity utilization rates will be moderate to low unless a major mill closes down. In the latter case, some short-term price pressure could result.

Over half of the bleached pulp sold in the United States is imported from Canada, the world's largest producer. Bleached market pulp is a residual product since most domestic paper producers take what they can after meeting their own papermaking requirements. If capacity is tight in the United States tissue and printing/writing paper sectors, the supply of bleached market pulp is also likely to be tight.

TABLE III-12

EFFECT OF ENVIRONMENTAL REGULATIONS ON INSULATING PULP PRICES

Environmental Regulation	Existing Industry		
	Investment Required \$ Millions	Necessary Price Increase \$/Ton	% 1975 Price ¹
EPA WATER			
1977	102	13.28	3.52
1985	52	9.99	2.4
MSPS	—	—	—
FEDERAL AIR			
SDPS	22	1.86	0.5
MSPS	—	—	—
OSHA NOISE	9	.59	0.1
TOTAL	185	26.01	6.57

¹1975 Price \$398

SOURCE: Arthur D. Little, Inc., estimates.

F. PRINTING, WRITING AND RELATED PAPERS

1. Product Description

The printing, writing, and related papers sector consists of four product groupings: coated printing and converting paper, uncoated book paper, writing paper, and related papers. Industry statistics also include bleached bristols in this sector, but since these are produced in bleached paperboard mills, this analysis includes them within the bleached board sector. All of the ~~paper~~ writing papers employ bleached pulp and are used primarily for printing, publishing, stationery, and a variety of paper converting applications.

The commodity grades generally are sold by the producer directly to large customers; both commodity and specialty grades are distributed through paper merchants or other wholesalers to small printers, publishers, and paper converters. The paper is usually finished by the paper mill into rolls or sheets ready for final use by the printer or converter.

2. Demand

Printing and writing papers are used in a variety of applications; hence, consumption is influenced by a number of demand patterns. Coated printing paper, particularly the publication grade, is influenced not only by the business cycle effect on advertising expenditures but also upon the share of the advertising market that magazines are able to maintain in competition with direct mail, newspapers, television, and radio. The rapid increases in postal costs incurred by the magazine industry have caused a substantial reduction in the weight of publication paper over the past ten years in order to reduce magazine weight and distribution costs. Hence, measuring consumption on the basis of tons of paper consumed understates the growth in surface area and dollar value.

Book printing growth primarily affects the growth of uncoated book, offset paper and coated paper that employs a nongroundwood base sheet. The large schoolbook segment of this market is heavily influenced by Federal and state aid to education programs while demand in the trade book segment is influenced heavily by shifts in disposable personal income and educational levels of the population.

The general commercial printing sector of the market consumes the whole spectrum of the printing paper grades for a wide variety of applications including direct mail advertising, brochures, catalogs, circulars, flyers, and financial documents. This diversity of end uses causes consumption to correlate well with the GNP. Label and wrap printing, which is a specialized component of the commercial printing industry, also has a consumption pattern that follows the GNP. This sector consumes primarily paper coated on one side only.

One of the largest components of the writing paper grade category is register bond or forms bond used for a variety of business forms. As a result, consumption in this end use fluctuates closely with the industrial production index. Other major writing paper applications include business stationery, copy machine paper, and personal stationery. The combined demand for these applications also correlates with GNP.

U.S. consumption of all printing and writing paper grades grew at the rate of 5.5% per year between 1960 and 1968, and 5.2% per year between 1968 and 1973, on a tonnage basis. Within this grade spectrum, forms bond grew at about 10% per year while the growth of coated one-side label and paper has been about 2% per year.

There has been some experimentation with plastic printing papers, but these products have found only relatively small market niches in applications which require high tear strength and water resistance. Examples are certain types of maps and book covers and children's books. Thus, plastic printing papers have not threatened the large volume applications for wood fiber papers primarily because they are considerably more expensive on both a tonnage and surface area basis.

There has been considerable competition among the various grades of printing papers for certain applications. In magazine printing, for example, coated papers have virtually displaced uncoated groundwood papers, which once held this entire market. More recently, carbonless copy papers have been displacing forms bond and carbon paper in business forms. Obviously, these shifts created advantages for certain suppliers but they generally do not affect the overall demand for paper in a given application outside of possibly causing a change in the weight of paper used. Only the coated/uncoated groundwood substitution had a significant effect on demand for two product sectors.

Price elasticity of demand for printing/writing papers is among the lowest of the industry's product sectors according to this study's econometric analyses. It indicates a coefficient of 0.26. This is not surprising in light of the essential information transfer functions the products perform and the absence of significant nonpaper substitutes.

3. Supply

Printing/writing papers are produced by an extremely wide variety of processes. They may be made in paper mills integrated to all of the bleached chemical pulps (kraft, sulfite, soda, and cotton fiber), to groundwood pulp and to deinked wastepaper, as well as in mills not integrated to pulp. In general, the producers of the large-volume commodity grades are fully integrated to kraft, groundwood or sulfite pulp mills while the producers of higher priced specialty papers are either not integrated or only partially integrated to chemical fiber or deinked pulp. Most of the paper machines, particularly the smaller ones, are quite versatile and produce a variety of printing/writing paper grades.

The market is relatively fragmented compared with most other paper industry product sectors. Table III-28 shows that the 8 largest producers, all of whom are integrated to pulp, account for 42% of U.S. capacity, but over 60 other firms compete in this product sector.

A look at specific products lines within the printing and writing category, however, reveals a much greater supplier concentration. Consolidated Papers, for example, has nearly a 10% share of the total U.S. capacity for coated papers and an even larger share of the magazine paper market in which it specializes. Great Northern-Nekoosa is the leading supplier in the writing paper sector, particularly in forms bond, although it has only a 4.4% share of the total printing/writing paper market.

The supply is considerably more concentrated on the West Coast than elsewhere with Boise Cascade, Crown Zellerbach, Georgia Pacific, Simpson-Lee, and Weyerhaeuser providing all of the market requirements except for some specialty grades which are shipped in from the East. There are also concentrations of supply in the North Central and Northeastern regions, but the suppliers there do not appear to be enjoying any significant monopolistic advantages since the papers are shipped long distances between regions in the large eastern and central markets.

TABLE 111-23

CONCENTRATION OF U.S. PRINTING AND WRITING PAPER SUPPLIERS, 1975

Company	% of U.S. Capacity	Number of Mills ¹
International Paper	9.6	8
Champion	6.1	4
Hood	6.0	4
Great Northern-Nekoosa	4.6	6
Scott	4.1	4
Vestco	4.1	3
Hammermill	4.0	6+
Bainbridge	3.8	4
Top Eight Companies	42.1	
Other Suppliers (About 63 Companies)	57.9	
TOTAL	100.0	

¹Partial ownership of mill indicated by +.

SOURCE: Luckenbach's Directory of the Paper and Allied Trades, 1975,
Arthur D. Little, Inc., estimates.

4. Prices

As was the case with most other paper products, printing and writing paper prices rose rapidly after price controls were lifted in March 1974. Throughout most of the 1980's, however, prices were very stable in spite of several significant cycles in the supply/demand balance. This pattern probably was caused by the entry of new producers attracted by the relatively high growth of this sector coupled with productivity improvements which held costs in line. The rapid price increases in 1975-74, were caused by a very tight supply/demand balance coupled with rapidly rising costs, particularly the cost of bleached chemical pulp for nonintegrated mills. However, producers that were not integrated to pulp production were barely able to maintain their profit margins because market pulp prices rose faster than the prices they obtained for their end products. Producers that were integrated to pulp, however, were able to improve profit margins significantly. Figure III-7 shows the trend in printing/writing paper prices versus capacity utilization since 1987.

5. Import/Export Balance

U.S. imports and exports of printing and writing papers are small and nearly in balance. In 1973, for example, imports amounted to 180,000 tons and exports to 220,000 tons. Imports and exports are low principally because these grades carry a relatively high import duty in the United States and in most other countries. The U.S. import duty on coated papers is so high that there have been no imports of this grade since before 1980.

6. Price Impacts

The printing/writing papers sector is comprised of many products. The long-run price impact was estimated using two major product categories — book paper and bond paper — that would have representative impacts. The estimated long-term impact will be a 6.3% increase (\$28 per ton) over the price of book paper and bond paper that would prevail in the absence of the studied regulations. The existing printing/writing paper industry requires an increase of \$28 per ton, which is equivalent to 4.9% of the 1975 composite price for the sector (Table III-24).

Consumers will face price increases in books and magazines as a result of price increases in printing/writing papers. The price of a \$0.75 magazine could increase by 1.2% (\$0.09) as a result of the studied environmental regulations.

7. Output Impacts

The price elasticity of demand estimated for printing/writing papers is 0.26. This means that a long-run price increase of 6.3% will be accompanied by a demand reduction of 1.6%.

8. Supply/Demand Balance

Printing/writing papers are one of the high growth sectors of the pulp and paper industry. According to the demand forecast based upon the Chase Econometrics CEAQ scenario, there will be tight capacity during the 1980's (Figure III-8). If demand grows at the upper bound of the forecast, some capacity pressure could occur in 1977. If a recession fails to materialize in 1978, tight capacity could occur beginning in 1980 even with moderate growth in demand. Some mills will shut down as a result of water effluent regulations, amounting to 2.2% of 1977 capacity and 1.0% (cumulative) of 1983 capacity.

FIGURE III.7
PRINTING AND WRITING PAPER
MARKET PRICE
VERSUS CAPACITY UTILIZATION

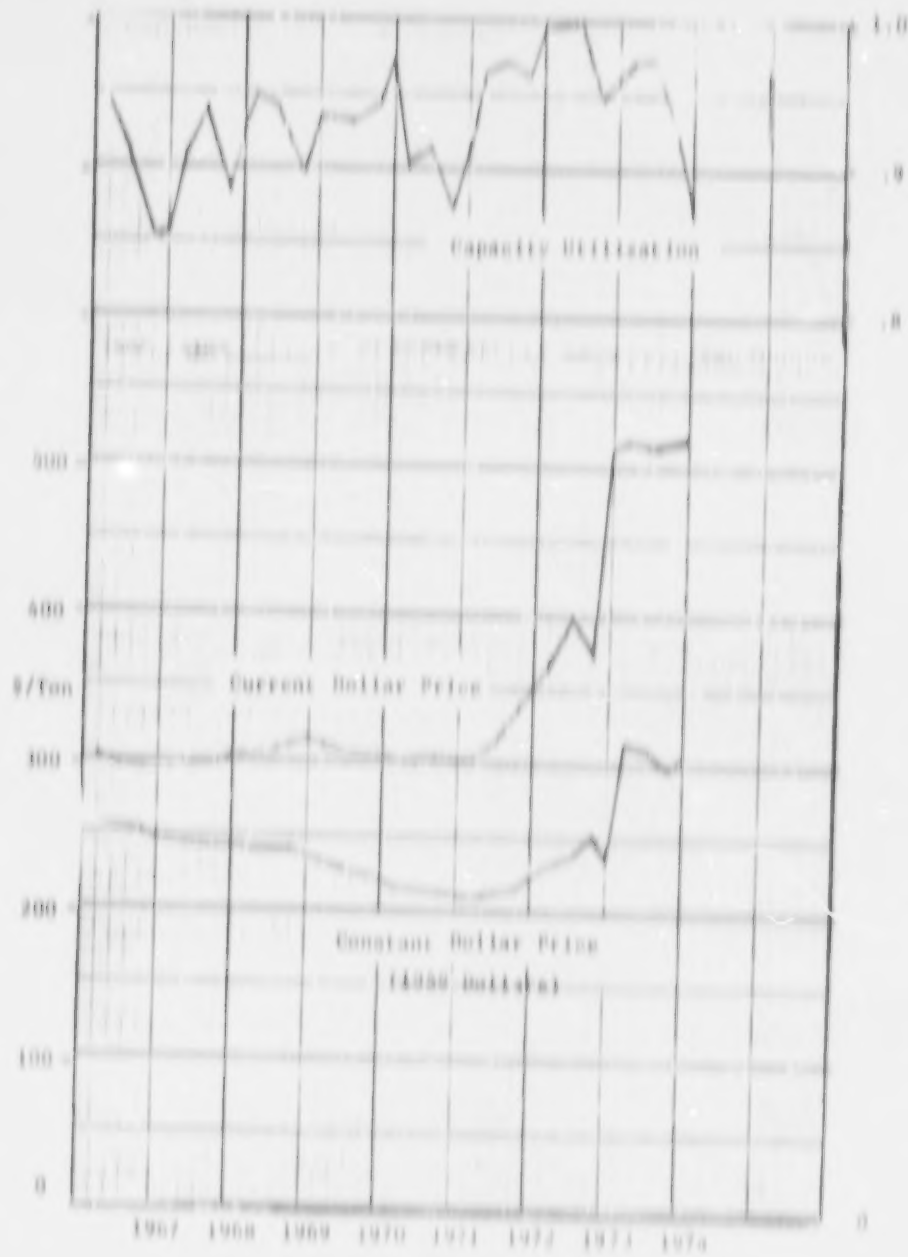


TABLE III-34

EFFECT OF ENVIRONMENTAL REGULATIONS ON PRINTING AND WRITING PAPER PRICES

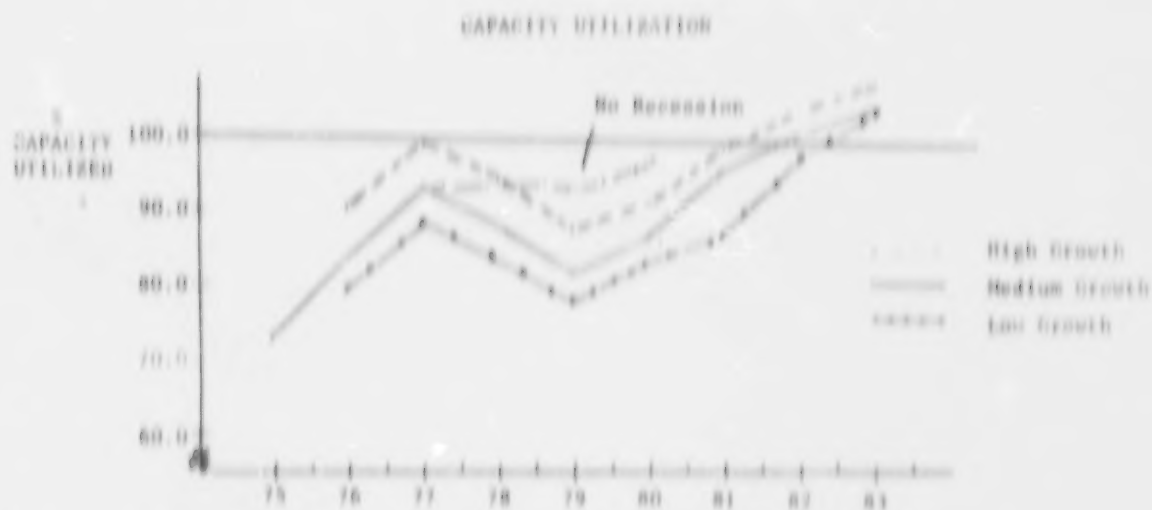
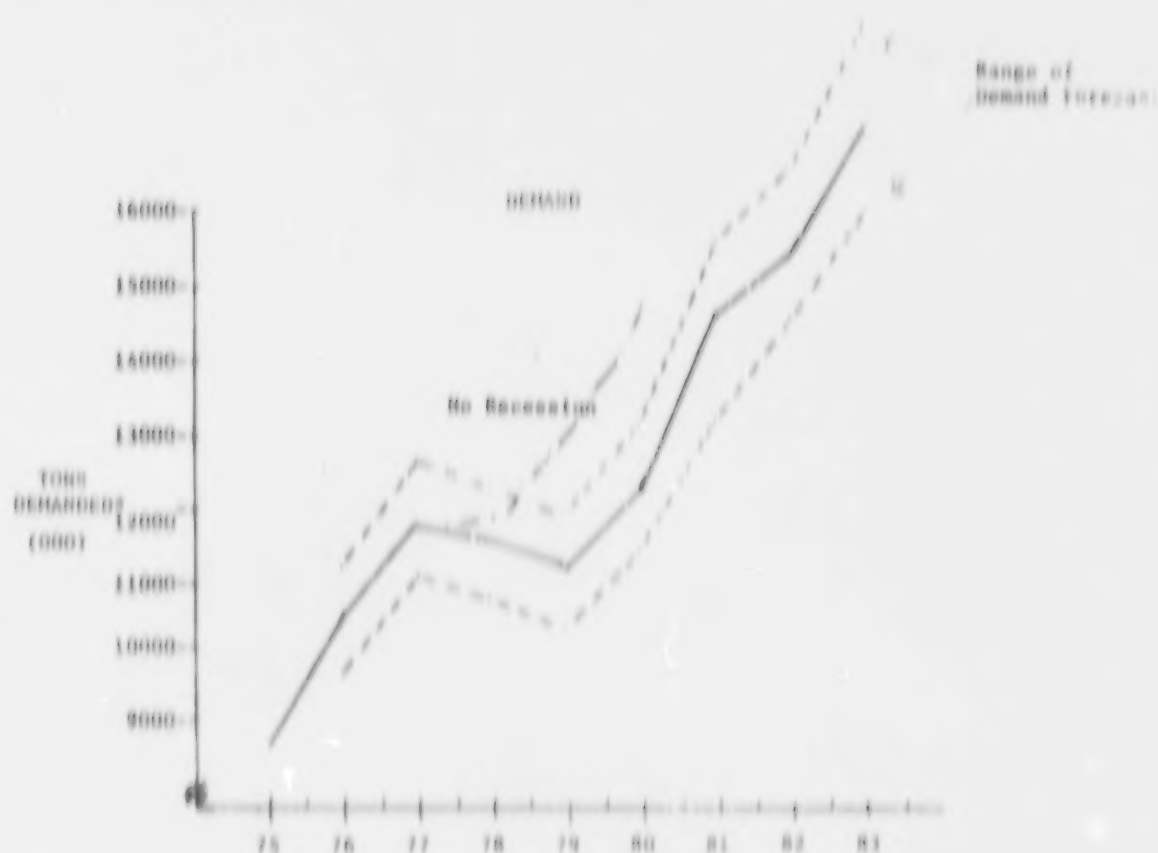
Environmental Regulation	Existing Industry			Long-Run Price Effect	
	Investment Required \$/million	Necessary Price Increase \$/ton	1985 Price ² \$/ton	\$/ton	% Baseline Price
EPA ACTION					
1977	385	12.75	1.1	-	-
1983	363	1.50	1.1	-	-
1985	-	-	-	21	2
FEDERAL ACTION					
1975	293	1.09	0.5	3	0.2
1985	-	-	-	1	-
1988	101	1.40	0.2	4	0.2
TOTAL	1,752	24.95	2.5	25	0.3

1985 ACTION 1988

²Baseline Price: Book Paper and News Paper Composite - \$445.

SOURCE: Robert A. Lott, Inc., estimates.

FIGURE III-B
PRINTING AND WRITING PAPERS
FORECAST OF DEMAND AND CAPACITY UTILIZATION



*Total U.S. Consumption

G. BLEACHED BOARD

1. Product Description

Bleached board and bristols were combined in the economic analysis because while they are sold to totally different markets, they are produced in the same mills, in some cases by interchangeable machines. Thus, the capacity utilization rates of the suppliers reflect the demand levels of both products.

Bleached paperboard, often referred to as SBB (solid bleached sulfate), is by far the larger-volume and faster-growing product with about four million tons produced in 1973. It is used almost entirely to produce folding cartons and paper cups, plates and trays. SBB is produced from a combination of fully bleached hardwood and softwood pulps made by the sulfate or kraft process. Most of this board is coated with clay pigment and/or polyethylene film to enhance its printing characteristics and/or barrier properties.

Bleached bristol production amounted to about 1.1 million tons in 1973 and 1974. Principal applications are tabulating and index cards, file folders and tags. Unlike SBB, these products are usually made from semibleached pulp and are not coated. Demand for bristols has been essentially static since 1960 primarily because of declining use of tabulating cards as business machines are designed for greater use of tape input/output and larger internal memory banks. Therefore, the discussion will focus on the larger and faster growing markets for bleached board.

2. Demand

Board applications are by far the largest and most pivotal markets for bleached board; hence, the discussion of demand characteristics focuses on this market. Board encompasses all paperboard materials used to produce folding cartons, milk cartons, cups/plates/trays, set-up boxes and related products. Materials from two other industry product sectors compete with SBB in many of these applications: recycled paperboard and unbleached kraft. Board accounted for nearly 80% of all paperboard production and about 15% of total paper and paperboard production in 1973. Table III-26 shows that SBB and recycled board are by far the most important grades, with about 95% of total 1973 board production.

Recycled paperboard is generally made from mixed grades of wastepaper. The folding type is usually pigment coated or lined with bleached or deinked pulp to improve its appearance and printing characteristics. The set-up or nonfolding type, which is heavier and stiffer, is sometimes coated or made with a white liner, but usually employs a coated paper outer liner. Its principal applications are shoe boxes, department store boxes, and hardware boxes.

Board demand, as measured by apparent domestic consumption, was about 8.2 million tons in 1973. Total demand increased at the rate of about 1% per year from 1968 to 1973. SBB consumption increased at the rate of about 3% per year, while consumption of recycled paperboard declined at the rate of about 2.1% per year during this period. SBB gained market share at the expense of recycled board primarily because its performance/cost relationship has been superior to that of recycled board in many applications where they compete directly. Most of this direct competition occurs in folding carton applications, which accounted for about 55% of total board production in 1973.

TABLE 111-25

U.S. BORDOARD PRODUCTION BY MAJOR GRADES AND USES, 1973

	Thousand Tons	%
<u>Solid Bleached Paperboard</u>		
Folding Carton	2720	20
Milk Carton and Food Service	1594	19
Linerboard	120	2
Other	134	2
Exports	280	3
Total Bleached Paperboard	3864	60
<u>Recycled Paperboard</u>		
Folding Carton	2522	30
Set-Up	465	5
Other	1191	16
Total Recycled Board	4178	69
<u>Unbleached Kraft Paperboard</u>		
Folding Carton	455	5
TOTAL BORDOARD	8497	100

SOURCE: API, Statistics of Paper and Paperboard, 1974

Table III-26 shows a breakdown of 1974 folding carton shipments by major end use. Food packaging, both dry and wet, is the largest folding carton application. SMM dominates in applications where:

- Cleanliness is important — e.g., wet/moist/oily food packaging. (The U.S. Food and Drug Administration has prohibited use of recycled board in direct contact with wet foods.)
- Aesthetics are important — e.g., high value added drug/cosmetic packaging where high quality printing is desired and the higher cost of SMM can be absorbed more easily.
- A high strength/weight relationship is important — e.g., beverage carriers (although coated unbleached kraft board is also strong in this application).

Recycled paperboard dominates in applications where:

- An inner lining is used — e.g., dry cereal/crackers packaging.
- Economics is the dominant criterion for the carton stock used e.g., lower value-added packaging for soap, detergents and paper goods.

Competition from nonpaper products has also been important in most bleached board applications. Plastics have made a significant penetration into boxboard markets. Frozen food cartons are being threatened by plastic bags; milk cartons are being displaced by blow-molded high density polyethylene milk bottles; and paper cups/plates/trays are facing significant competition from polystyrene containers.

In spite of the intense intra- and inter-industry competition which bleached board faces, its price elasticity of demand is the lowest of the paper industry product sectors. The econometric analysis used in this study indicates a coefficient of 0.18 over the period 1960-1974. This low price sensitivity is probably due mainly to the fact that the prices of all competing materials moved in the same direction at about the same rate. Thus, the cross-elasticity of demand was insignificant over this period. In addition, packaging materials no longer are discretionary consumption items but are fundamental to the entire U.S. distribution system.

3. Supply

Bleached board capacity was about 3.4 million tons in 1973 and the sector achieved an annual operating rate of 98%. Operating rates in this sector traditionally have been higher than that of any other paper industry sector, generally fluctuating between 90% and 100% of capacity. The bleached board producers apparently appraise their practical maximum capacity more realistically than producers in other sectors. Another factor which smooths year-to-year fluctuations in operating rate is that many producers use their paperboard machines to produce market pulp when bleached board demand is weak, thus shifting their capacity to another product sector.

There are about 20 SMM board producers in the United States, of which the eight largest accounted for approximately 67% of 1975 U.S. bleached paperboard capacity (Table III-27). Thus, bleached paperboard is a relatively concentrated market sector.

TABLE III-29
FOLDING CARTON END-USES, 1973

	<u>% of Total Tons</u>	<u>% of Total Dollars</u>
Food-Dry	20.4	19.1
Food-Wet	13.8	15.1
Soap	8.6	6.9
Paper Goods	6.1	6.1
Beverage Carriers	6.1	6.7
Hardware	5.7	8.2
Biscuits & Crackers	6.1	4.0
Candy	4.6	4.6
Retail & Laundry	4.6	4.1
Medicinal	3.0	6.9
Perishable Bakery	3.6	4.6
Tobacco	3.1	2.4
Textiles	2.8	2.9
Cosmetics	2.3	4.6
Other	<u>3.9</u>	<u>7.8</u>
	100	100

SOURCE: Paperboard Packaging Council

TABLE III-27

CONCENTRATION OF BLEACHED PAPERBOARD AND BRISTOLS, 1975

<u>Producer</u>	<u>% of U.S. Total</u>	<u>Number of Mills</u>
International Paper	25.1	6
Westvaco	7.5	1
Easton	7.0	1
Federal Paperboard	6.9	1
Potlatch	5.6	1
Weyerhaeuser	5.3	2
Continental Can	5.0	1
Champion	4.9	1
Top 8 Companies	67.1	
Other Suppliers (About 18 Companies)	32.9	
TOTAL	100.0	

SOURCES: Lockwood's Directory of the Paper and Allied Trades, 1975;
Arthur D. Little, Inc.; estimates.

All of the leading producers of bleached paperboard are integrated in on-site pulp production, and control a significant portion of the woodlands that support their pulp mills. Most are integrated forward to the production of folding cartons, milk cartons, or other end products. Most of the bleached paperboard mills are located near their fiber resources in the South and in the West.

4. Prices

Table III-28 shows that the price differential between bleached paperboard and recycled paperboard has been increasing since 1973. In 1973, the differential between solid bleached and recycled paperboard was \$58/ton compared with \$70/ton by late 1974. However, most of the apparent increase was caused by a trend to reduce the weight of bleached board to make it more competitive by offering a greater area yield per ton. Since the strength and stiffness characteristics of SMM are superior to those of recycled board at a given caliper level, a higher-caliper recycled board must typically be used to provide performance similar to that of SMM. Thus, prices for a given application must be compared on an area basis to truly reflect the economic competitiveness of recycled board versus SMM board. This factor plus printability advantages means that the current price differential reflects a competitive equilibrium between SMM and recycled paperboard.

Competition from recycled paperboard and plastics, however, apparently limited the price increase that the bleached board producers could obtain. In 1975, solid bleached board sold at only \$15 per ton more than bleached softwood pulp, although it cost considerably more to produce. Nevertheless, most producers refrained from shifting their machines to market pulp because they believed the resulting addition to pulp supply would undermine prices and thus "ruin" the market.

Figure F-9 shows the bleached board and Bristol's price trend versus capacity utilization since 1960. Both current and real prices trended downward until 1972. Prices rose sharply in 1973-1974, but not as much as those of many other paper products. Price movements have not been sensitive to changes in capacity utilization. This insensitivity can probably be explained by the moderate concentration of the bleached board sector coupled with the need to maintain a price/performance equilibrium with competing products.

5. Import/Export Balance

Imports of bleached paperboard are insignificant. Some bleached paperboard (about 7% of 1974 production) is exported to markets where U.S. producers are competitive by virtue of their large scale and relatively low cost of fiber resources.

6. Price Effects

As indicated in Table III-30, there will be a long-term price increase of 8% in bleached board because of the studied environmental regulations. The existing industry requires a 5% increase over 1985 market prices to recover the incremental cost of compliance with the studied regulations.

The effect of this price increase upon the end consumer will be small. The 8% long-term price impact translates into an 0.4% increase in the price of a half gallon of milk sold in an SMM carton.

TABLE III-28

BLEACHED PAPERBOARD AND RECYCLED BOXBOARD PRICE TRENDS

(Dollars per Ton)

<u>Year</u>		<u>Bleached Paperboard</u>	<u>Recycled Boxboard (20-Point Clay-Coated)</u>
1973	January	210	152
1974	January	250	190
	March	280	220
	May	280	230
	September	320	260
	October	350	260
	November	350	280
1975	January	350	280

SOURCE: H.C. Wainwright and Company, industry price surveys.

FIGURE III-9
BLEACHED BOARDS AND BRISTOLS
MARKET PRICE
VERSUS CAPACITY UTILIZATION

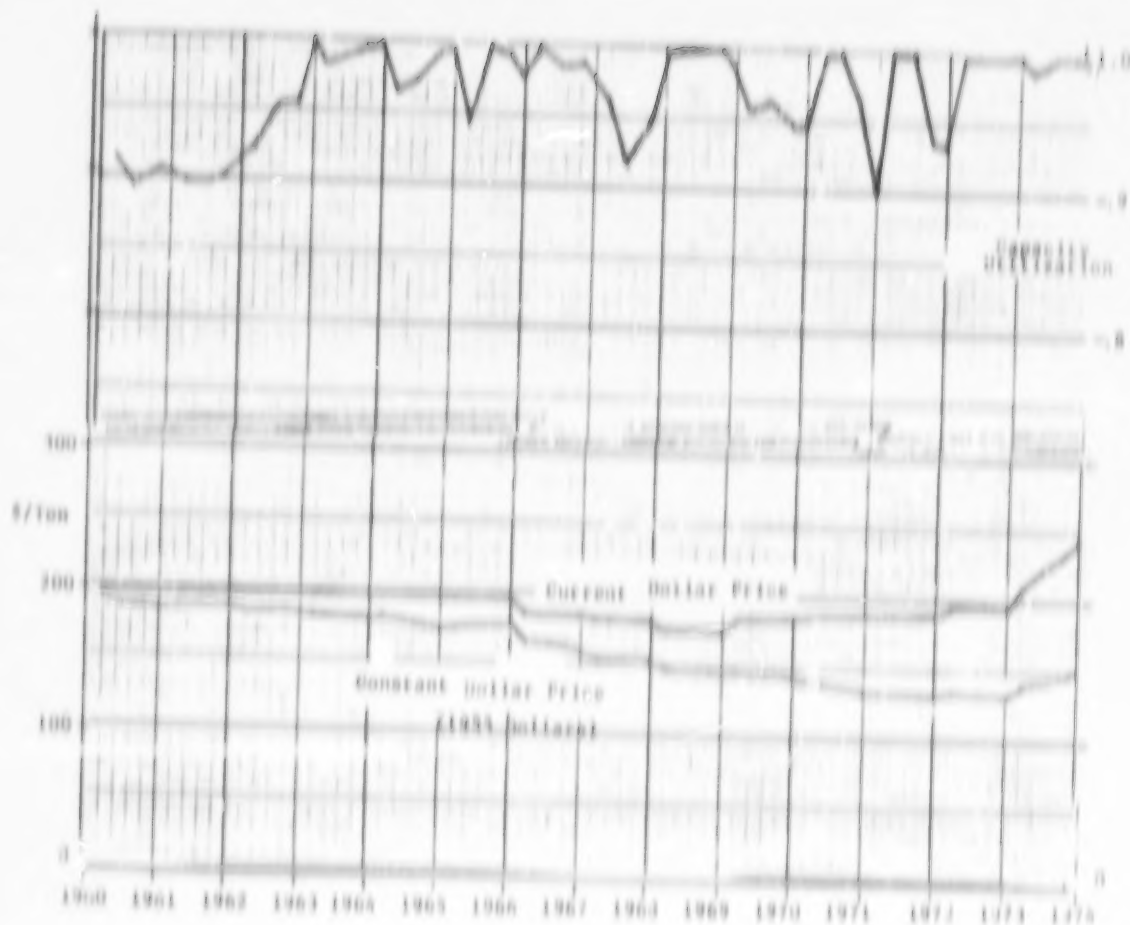


TABLE 111-28
EFFECT OF ENVIRONMENTAL REGULATIONS
ON S&P BOND PRICES

Environmental Regulation	Existing Industry				Long-Run Price Effect	
	Investment Required \$ mil./yr.	Necessary Price Increase \$/Share	% 1975 Price		\$/Share	% Baseline Price
CO ₂ Water						
1971	\$1.74	\$2.08	1.32	-	-	-
1983	34	6.33	1.7	-	-	-
1975	-	-	-	24.9	6.42	
Federal Air						
1975	10	2.7	.8	-	-	-
1975	-	-	-	1.9	0.8	
1975 Water	10	4	2.1	2.1	0.9	
Total	24.9	\$27.45	5.85	\$29.9	8.17	

¹ 1975 Price = 1953

² Baseline Price = 1962

See Capacity Differential = 1.32

SOURCE: Arthur D. Little, Inc., estimates.

7. Output Effects

The price elasticity of demand measured for bleached board is quite low (0.18), and, as a result, the impact of a price increase upon demand is small. The long-term price increase of 8% will reduce demand by 1.4%. The price increase required by existing industry (5.0%) will reduce demand by 0.9%.

The elasticity of demand estimated in the econometric model could be understated because of the pricing behavior of bleached board producers during the late sixties and seventies, when prices for SBB board were about the same as those for bleached market pulp. Producers appear to have held prices down to prevent greater inroads by plastic substitutes. If, unlike the period 1968-1974, the studied environmental regulations cause the price of SBB board to increase faster than prices of substitutes, the reduction in demand could be greater, and capacity utilization rates will fall.

8. Projected Supply/Demand Balance

High operating rates are forecasted for the bleached board product sector for much of the 1976 to 1980 period (Figure III-10). This sector has traditionally operated at higher capacity utilization rates than the industry, in part because of the more realistic definition of maximum capacity by bleached board mills. Some capacity pressure could appear as early as 1977. If the 1976 recession forecast by Chase Econometrics fails to materialize, a tight capacity situation will exist by 1980.

No mill shutdowns will result in this product sector from environmental regulations. The main reason that expansion may not occur in this sector in response to high operating rates is uncertainty over the price of plastic substitutes.

H. TISSUE

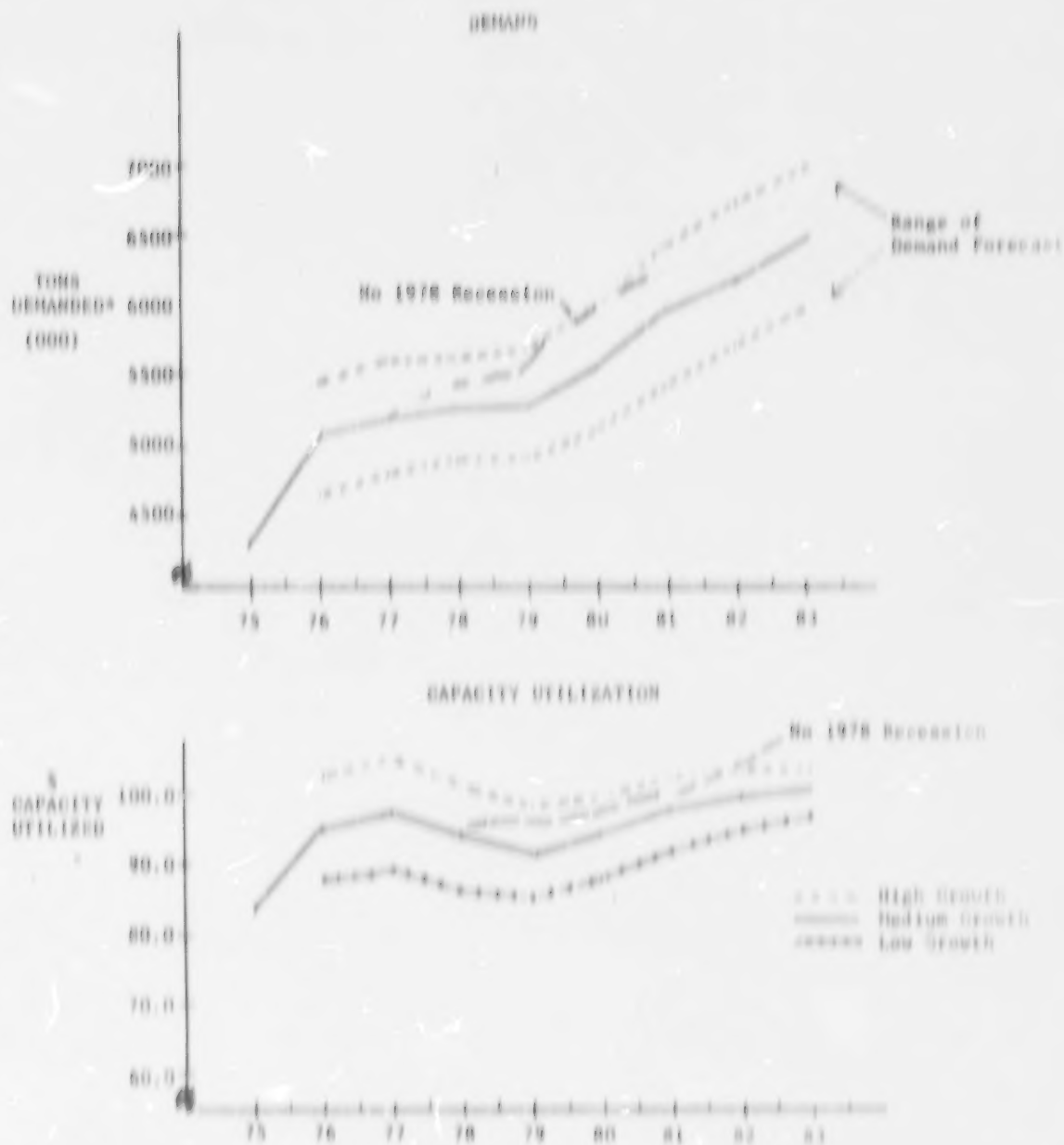
1. Product Description

The tissue sector of the pulp and paper industry comprises both sanitary and nonsanitary grades of tissue paper that are sold to consumer and industrial market sectors. Sanitary tissue grades include bathroom and facial tissue, napkins, towels, and wipers. Nonsanitary tissue grades include wadding, wrapping, and cellulose wadding tissues. The so-called thin papers, such as carbonizing tissue, are not included in the tissue market. They are included in the printing/writing and related papers sector, with which they are more closely related from a market point of view.

Table III-30 shows that the sanitary tissue segment accounted for about 94% of total 1974 tissue production. Table III-31 shows that consumer tissue accounted for about 70% of total sanitary tissue production in 1974.

All of the above tissue grades are usually made from a combination of various bleached pulps, including sulfite and kraft (both softwood and hardwood), small amounts of groundwood pulp, and deinked or high-grade wastepaper.

FIGURE III.10
BLEACHED BOARD AND BRISTOLS
FORECAST OF DEMAND AND CAPACITY UTILIZATION



*Total U.S. Consumption

Source: Demand level derived from the econometric model in conjunction with Chase Econometrics forecast of economic indicators for CBO.

TABLE III-30

1974 PAPER PRODUCTION
BY PRODUCT

Product	Thousand Tons	% of Total
Sanitary Tissue	1474	36
Towels	1332	33
Napkins	639	16
Facial Tissue	353	9
Others	51	1
Other Sanitary	170	4
Total Sanitary Tissue	3612	90
Non-Sanitary		
Wrapping	66	1.6
Wadding	53	1.3
Industrial Cellulose Wadding	32	0.8
Other Non-Sanitary	109	2.7
Total Non-Sanitary Tissue	230	6
Total 1974 Paper Production	3842	100

Source: American Paper Institute

TABLE 111-31

1973, SANITARY TISSUE, CONSUMPTION
 DOMESTIC U.S. LABORATORY MARKET
 (L = On a tonnage basis)

	CONSUMER	INDUSTRIAL
Bathroom Tissue	81	19
Towels	63	37
Napkins	49	51
Facial Tissue	100	00
Wipes	25	75
Total Sanitary Tissue	70	30

SOURCE: American Paper Institute

2. Demand

Total domestic U.S. tissue consumption increased at the rate of about 6% per year from 1963 to 1968, and about 3.2% per year from 1968 to 1973. This recent slower growth rate indicates that this market is maturing. In the 1950's and 1960's, consumer sanitary tissue displaced reusable fabrics in the napkin and towel product categories. During this period, the tissue market was one of the fastest growing markets in the pulp and paper industry with average increases in excess of 6% per year. By 1968, however, most of this displacement was completed and consumer tissue consumption has since increased at a lower rate.

The demand for tissue in the industrial market also increased rapidly in the 1960's as the fast food industry proliferated and the demand for paper disposables increased accordingly. While the consumption of industrial tissue has increased at a higher rate than that of consumer tissue in recent years, the rate of growth is now decreasing as a result of a slowing of the growth rate of the fast food/institutional food businesses which had been the chief growth component.

In the future, the demand for tissue products is expected to relate more closely to such factors as consumer disposable income and population growth (since tissue displacement of reusable fabrics has subsided). As such, the tissue market will probably grow more slowly than real GNP through 1983. However, the consumer segment of the tissue industry will continue to be more recession-proof and less subject to cyclical swings in consumption levels than the pulp and paper industry or the economy as a whole.

Consumer tissue is the paper industry's principal consumer product. Tissue producers rely heavily on consumer marketing/advertising/promotion to sell their product in consumer markets. Consumer sanitary tissue is usually sold on a direct basis from the paper producer converted to the grocery chain store. Both brand name and private label products follow this pattern.

Industrial sanitary tissue is typically distributed through paper merchants or industrial maintenance supply houses. From this distribution level, the product is ultimately purchased by the major fast food chains, as well as by hotels, restaurants, and institutional end users.

Because of the product's high bulk, it is very expensive to ship tissue over long distances. Thus, tissue normally is distributed on a regional basis, usually within 300 miles of converting locations (which are themselves typically located next to paper mills and near population centers).

Other than going back to reusable cloth fabrics, there are no economical substitutes for sanitary tissue products. However, it is possible that continued escalation of tissue prices may cause some consumers to economize on tissue use and possibly shift back to some extent to reusable cloth products. In the nonsanitary tissue area, waxing tissue has been and continues to be replaced by plastic film and foil materials, primarily because of the latter's superior performance characteristics.

The price elasticity of demand for tissue calculated by the econometric analysis in this study was 0.45 or about average for the bleached paper sectors. This moderately low coefficient is not surprising in light of tissue's essential uses, fairly low cost, and lack of significant substitutes.

3. Supply

U.S. tissue capacity was 4.3 million tons in 1974. Unlike most paper industry sectors, tissue production is spread evenly throughout the country (mostly near major metropolitan areas), as opposed to being centered near the primary fiber resource areas of the South and West.

The four largest tissue producers are Scott, Procter and Gamble, Kimberly Clark, and American Can (Table III-32). These four producers accounted for about 50% of total U.S. tissue productive capacity in 1975. Thus, this market sector is relatively concentrated compared to other paper industry sectors.

In addition to having substantial financial resources, the leading tissue producers are largely vertically integrated. The major tissue producers: (1) are integrated to pulp on a company

TABLE 11'-12
CONCENTRATION OF TISSUE SUPPLIERS, 1975

	<u>A. U. S. Capacity</u>	<u>Number of Mills</u>
Scott	24.1	8
Procter and Gamble	12.8	5
Kimberly Clark	9.9	5
American Can	9.0	4
Crown Zellerbach	6.7	6
Fort Howard	6.6	1
Georgia-Pacific	6.0	5
Brown	<u>2.5</u>	2
Top Eight Companies	77.6	
Other Suppliers (About 43 Companies)	<u>22.4</u>	
TOTAL	100.0	

SOURCES: Lockwood's Directory of the Paper and Allied Trades, 1975.
 Arthur D. Little, Inc.; estimates.

basis, although not necessarily on a mill-site basis;¹ (2) control a significant portion of the woodlands that support their pulp mills; and (3) are fully integrated on-site to tissue converting. The practice of these industry leaders implies that substantial vertical integration is an important component for success.

4. Prices

Most tissue paper producers convert their product at the site where the tissue paper is made.² The amount of tissue paper sold in the form of jumbo rolls (unconverted) is very small. Thus, the most meaningful tissue prices are converted product prices.

Figure III-11 shows the trend in tissue prices and capacity utilization since 1960. This figure shows that like most other paper markets, the tissue paper prices increased relatively little during most of the 1960's. In 1973, however, a fairly tight supply/demand balance, coupled with rising costs, began to generate significant price escalations although not nearly as high as those in other paper industry sectors. Between November 1973 and October 1974, average sanitary tissue prices increased by about 30%. Note that the price series do not reflect promotional discounts granted the retailers, particularly during weak markets and this masks the correlation with capacity utilization. (Tissue is the only product sector that does not reflect discounts in its market price.)

When discussing tissue prices, it is important to understand that there is significant product differentiation in terms of quality and brand name identification in the consumer market sector. Brand name tissue products, which rely strongly on consumer advertising for product differentiation, are priced higher than private label tissue products. Also, tissue grades that utilize a large proportion of detacked wastepaper are generally priced below products made largely from chemical wood pulp fiber. This reflects a somewhat lower consumer acceptance for tissue made from the typical wastepaper furnish, apparently because of the product's slightly off-white color. In the industrial market sector, there is far less product differentiation and price is viewed as a key determinant of a successful marketing program.

5. Import/Export Balance

There have been no significant imports of any tissue materials to the United States in the last 10 years, and exports have been less than 1% of total U.S. production over this period. Prevailing tariffs plus high transportation costs for bulky tissue products explain this low level of international trade.

6. Price Impacts

Of all the products studied, tissue had the highest price per ton in 1975, at \$700 per ton. Principally because of its high unit value, the tissue sector will incur the smallest relative price impact as a result of the environmental regulations studied. The long term price increase of \$31 per ton is only 4.4% higher than the long term price that would prevail without the studied regulations. The existing industry requires a price increase of about \$80 per ton to cover the incremental cost of compliance with the studied environmental regulations (Table III-33).

1. More than half of the output of this industry comes from tissue mills not integrated on-site to pulp.

2. In this case, converting refers to the functions of printing, die cutting, rewinding, folding/interfolding, and final packaging.

FIGURE III-11
 TISSUE MARKET PRICE
 VERSUS CAPACITY UTILIZATION

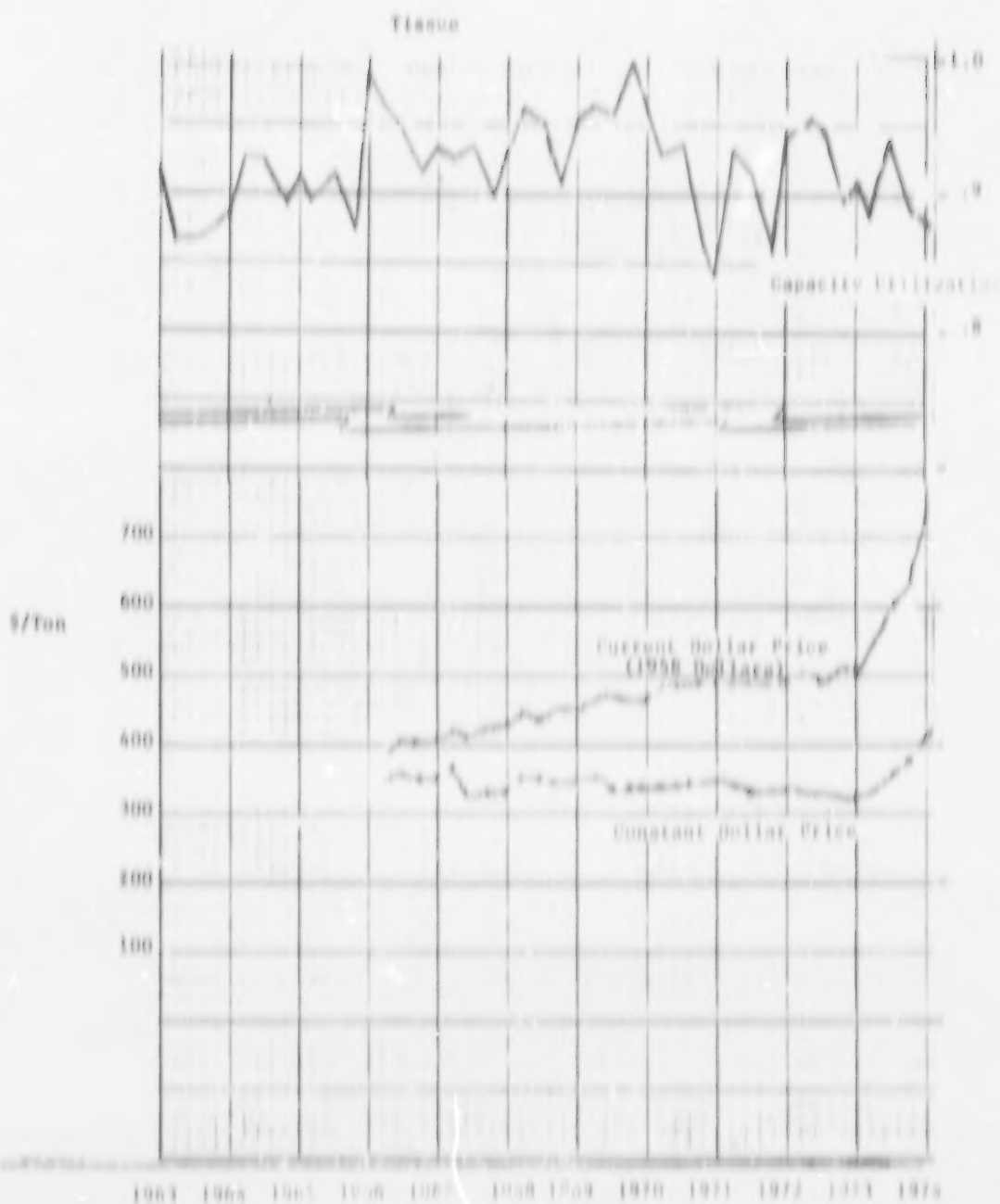


TABLE III-13

EFFECT OF ENVIRONMENTAL REGULATIONS ON TISSUE PRICES

Environmental Regulation	Existing Industry		Long-Run Price Effect	
	Investment Required \$ Millions	Necessary Price Increase \$/Ton	\$/Ton	% Baseline Price
FISH HARVEST				
1971	268	15.30	-	-
1983	155	8.82	22	2.9
FISHING BOATS				
1975	68	2.57	-	-
1985	-	-	3	0.4
1990 BOATS	47	2.12	8	0.9
TOTAL	539	28.82	33	4.3

1995 Price: \$28

Baseline Price: \$24

Source: Arthur A. Little, Inc., estimates.

Since tissue is consumed as a final product and the converting operations are done on site, the price impacts estimated also represent the ultimate relative price impact the consumer will face. In the long run, the consumer will therefore incur a 4.1% increase in the price of tissue.

7. Output Effects

The price elasticity of demand for tissue estimated by the econometric model is 0.45. This means that the price increase due to the studied environmental regulations of 4.1% will be accompanied by a 1.8% reduction in demand compared to the demand level that would have been obtained without a price increase.

8. Supply/Demand Balance

The forecast demand for tissue will result in average to low capacity utilization rates for the studied period (Figure III-12). Some price pressure may occur in 1983 because of estimated mill shutdowns, which are equivalent to 147,000 tons or 3.3% of 1975 capacity.

I. NEWSPRINT AND UNCOATED GROUNDWOOD PAPER

1. Product Description

These products were grouped in this analysis because they both utilize a substantial proportion (usually greater than 50%) of groundwood pulp in their fiber make-up, and they are often produced in the same mill. Other common characteristics are that both products are uncoated and are used in printing applications that do not require long storage or reuse since the groundwood pulp discolors when exposed to ultraviolet light. Thus, they are used for products such as newspapers (the dominant application), telephone directories, some mail order catalogs, and other printed articles that are generally discarded within one year.

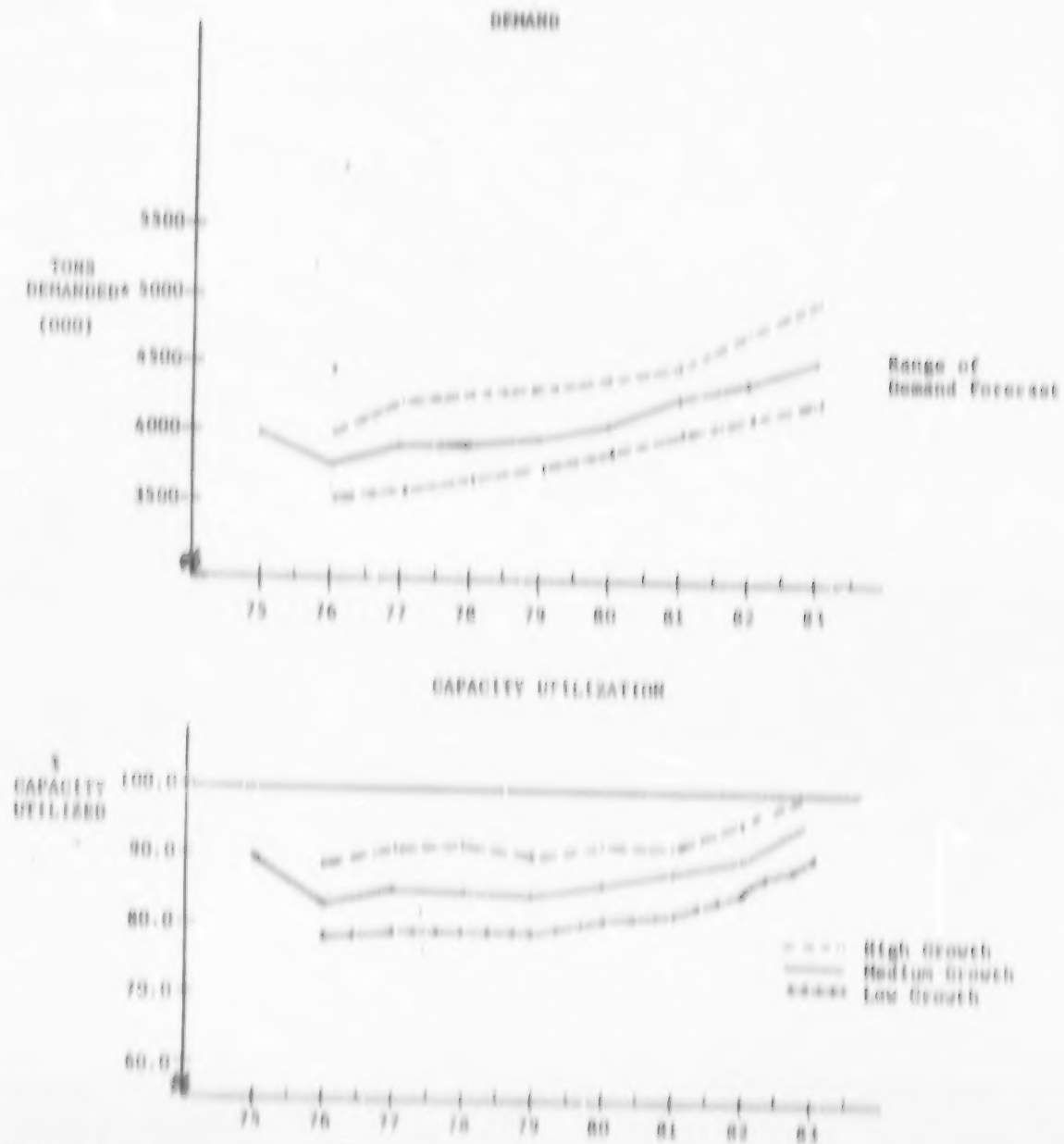
Newsprint is by far the largest major grade in this category, with a total U.S. consumption of about 11 million tons in 1974. It is generally made from a pulp furnish consisting of about 80% unbleached groundwood and 20% semibleached kraft or unbleached sulfate pulp (West Coast groundwood pulp is often lightly bleached). Three U.S. newsprint mills produce newsprint entirely from waste newspapers; as a result of their successful market penetration, this recycling trend is likely to grow in areas with high population and wastepaper density.

Uncoated groundwood paper is generally made from a furnish consisting of 30-50% of bleached chemical pulp and 50-70% of bleached groundwood pulp. Its principal applications are for telephone directories, catalogs, paperback books, low-priced magazines, comic books, and general commercial printing.

2. Demand

U.S. newsprint consumption has increased at an average rate of 2.0%/year since 1964. This puts it in one of the slower growth categories in the paper industry. Relatively rapid growth in the suburbs has compensated for the demise of the large metropolitan dailies and the relatively slow growth of all metropolitan newspapers. Consumption is highly related to growth in GNP because advertising space is the key determinant of newspaper size or lineage and therefore significantly affects newsprint consumption. Newspaper advertising has faced stiff competition from radio and particularly TV advertising media; thus, newsprint competes indirectly with these alternative methods of advertising.

FIGURE III-12
TISSE
FORECAST OF DEMAND AND CAPACITY UTILIZATION



*Total U.S. Consumption

Recently, a few new applications for groundwood papers have begun to develop in areas where no more than short-term use is required. The increasing price differential between groundwood and groundwood-free papers which occurred in 1974 increased the incentive to shift to groundwood. One such comparatively new application is in business forms where, in 1976, approximately 80,000 tons of newsprint and uncoated groundwood paper was substituted for the traditional forms bond paper which is made from 100% bleached chemical pulps.

U.S. consumption of uncoated groundwood papers grew at the average rate of 2.8% per year (1970-1976) making it a somewhat higher growth area than newsprint. However, uncoated groundwood papers have been replaced by coated papers in catalogs and magazines, and their consumption has also suffered from the demise of low-cost pulp magazines and comic books. The major recent growth areas have been business forms and advertising printing. Demand appears to be bolstered by the fact that the price differential below groundwood-free printing papers widened appreciably during 1974. In January 1976, for example, there was a \$205/ton differential between No. 3 uncoated offset book paper and catalog grade groundwood paper, whereas a year earlier the differential was about \$100/ton. This development should increase the use of uncoated groundwood paper in a number of commercial printing applications.

The price elasticity of demand for newsprint, as computed in this study, ranges from a relatively high 0.85 when measured by U.S. production to a relatively low 0.32 when measured by U.S. consumption (although the latter coefficient is not statistically significant). The most likely explanation for this pattern is that competition between U.S. and Canadian newsprint mills introduces substantial cross-elasticity.

3. Supply

Canadian newsprint mills play a pivotal role in supplying U.S. needs and, hence, are a key factor in the industry's competitive structure. Canada has become the world's largest newsprint producer by virtue of the suitability and relatively low cost of its pulpwood supply. Furthermore, there usually are no duties on newsprint, which enhances Canada's exports. In 1974, Canadian mills supplied about 70% of U.S. newsprint consumption and U.S. mills supplied the remaining 30%.

Table III-34 lists the capacity of the major North American newsprint suppliers. This does not necessarily reflect their share of the U.S. market since many of the Canadian producers have substantial overseas exports. The recent acquisition of the Price Company by Abitibi Paper Company has given it a dominant 17% share of North American capacity. International Paper, with a 10% share, traditionally was the major supplier.

North American newsprint supply is relatively concentrated. The top 14 firms have nearly an 80% share of the total North American capacity and about an equal total share of the North American market, while the top five producers have about a 50% share.

Table III-35 lists the capacity of the major U.S. uncoated groundwood paper producers. Imports of groundwood paper from Canada or elsewhere are not significant (117,000 tons in 1974); an import duty, coupled with the freight advantage enjoyed by U.S. producers in shipping this product, makes it difficult for nondomestic suppliers to compete.

TABLE 111-3A

CONCENTRATION OF NORTH AMERICAN NEWSPRINT SUPPLIERS, 1975

<u>Company</u>	<u>% of North American Capacity</u>	<u>Number of Mills (1)</u>
Abitibi-Price	17.0	11+
International Paper	9.9	3
MacMillan-Bloedel	9.7	3
Consolidated Bathurst	7.4	5
Bowaters	7.4	5
Ontario Paper	5.2	2
Kimberly-Clark	4.2	14
Boise Cascade	<u>3.7</u>	24
Top Eight Companies	64.5	
Other Suppliers (6 Companies)	<u>35.5</u>	
Total	100.0	

(1) Partial ownership in a mill indicated by +

SOURCE: "Newsprint Statistics", American Newspaper Publishers Assn.
April 12, 1976

TABLE 314-35

CONCENTRATION OF UNCOATED GROUNDWOOD PAPER SUPPLIERS, 1973

	<u>\$ U.S. Total</u>	<u>No. of Mills</u>
Great Northern-Bekoosa	27.4	2
Bowaters	16.8	1
St. Regis	12.4	2
Fraser	8.6	1
Appleton	5.7	1
Crown Zellerbach	5.3	2
Georgia Pacific	4.7	1
Kennebec River	<u>3.9</u>	1
Top Eight Companies	84.8	
Other Suppliers (about 12 Companies)	<u>15.2</u>	
Total	100	

SOURCE: - Lockwood's Directory of the Paper and Allied Trades, 1975.
 - Arthur D. Little, Inc., estimates.

Traditionally, the uncoated groundwood paper market has been viewed as an alternative use for old newsprint machines that are no longer competitive in the newsprint market. This is the route of entry used by all current suppliers. Recently, however, Great Northern-Nekoosa and Fraser Paper have installed new machines to increase their market share. These two companies, along with Bowater and St. Regis, are the major U.S. producers.

4. Prices

Newsprint prices traditionally have risen in gradual steps and have declined infrequently even though U.S. operating rates have fluctuated sharply. One explanatory factor is that fluctuations in world operating rates were not as severe as in the United States and prices behaved accordingly because of the substantial amount of newsprint trade between countries. Another factor is the relatively high market concentration and price leadership exhibited by six of the major North American producers.

Figure III-12A, however, shows that U.S. prices increased significantly beginning at the end of 1973 and rose rapidly after U.S. price controls were fully lifted in June 1974. The increases, led by Canadian firms trying to bolster their low profitability, were still not as high as in most other produce sectors, another indicator of an oligopolistic market. The western U.S. market, where newsprint traditionally sold below eastern prices, established a price premium in 1974; this was made possible both by tight market conditions and the fact that two producers dominate the western market.

A similar trend of price escalation took place for uncoated groundwood paper. As discussed earlier, groundwood-free printing and writing paper prices increased even more rapidly than those of the uncoated groundwood grades. This rapid increase indicates that uncoated groundwood prices relate more closely to newsprint prices, with which they are usually associated from a supply standpoint. The resulting wider price differential between the groundwood and non-groundwood grades makes the former more price competitive and should stimulate its demand.

5. Import/Export Balance

As mentioned previously, newsprint is the largest-volume paper product imported by the United States. In 1974, U.S. publishers imported 7.4 million tons, worth about \$1.5 billion, almost all of it from Canada. The United States is a relatively small newsprint exporter with a 1974 volume of about 100,000 tons, worth \$55 million. Most U.S. newsprint mills are more concerned about capturing a greater share of their own market than with vying with the Canadians in third markets.

An import duty plus a freight rate advantage for U.S. mills has kept imports of uncoated groundwood paper to a minimum. In 1974, reported imports were about 117,000 tons, but additional amounts were imported under a "newsprint" designation to avoid the duty. Exports were small, about 53,000 tons.

6. Price Impacts

Newsprint prices will increase by 5.7%, or \$16 per ton in the long run as a result of the studied regulations (Table III-36). The existing industry requires a price increase of 7.7%, or \$20.33 per ton over the 1975 price of \$265 to recover the incremental cost of compliance with the studied regulations. The reason for the apparent disparity between the price increase required by

FIGURE III-12A
 NEWSPRINT MARKET PRICE
 VERSUS CAPACITY UTILIZATION

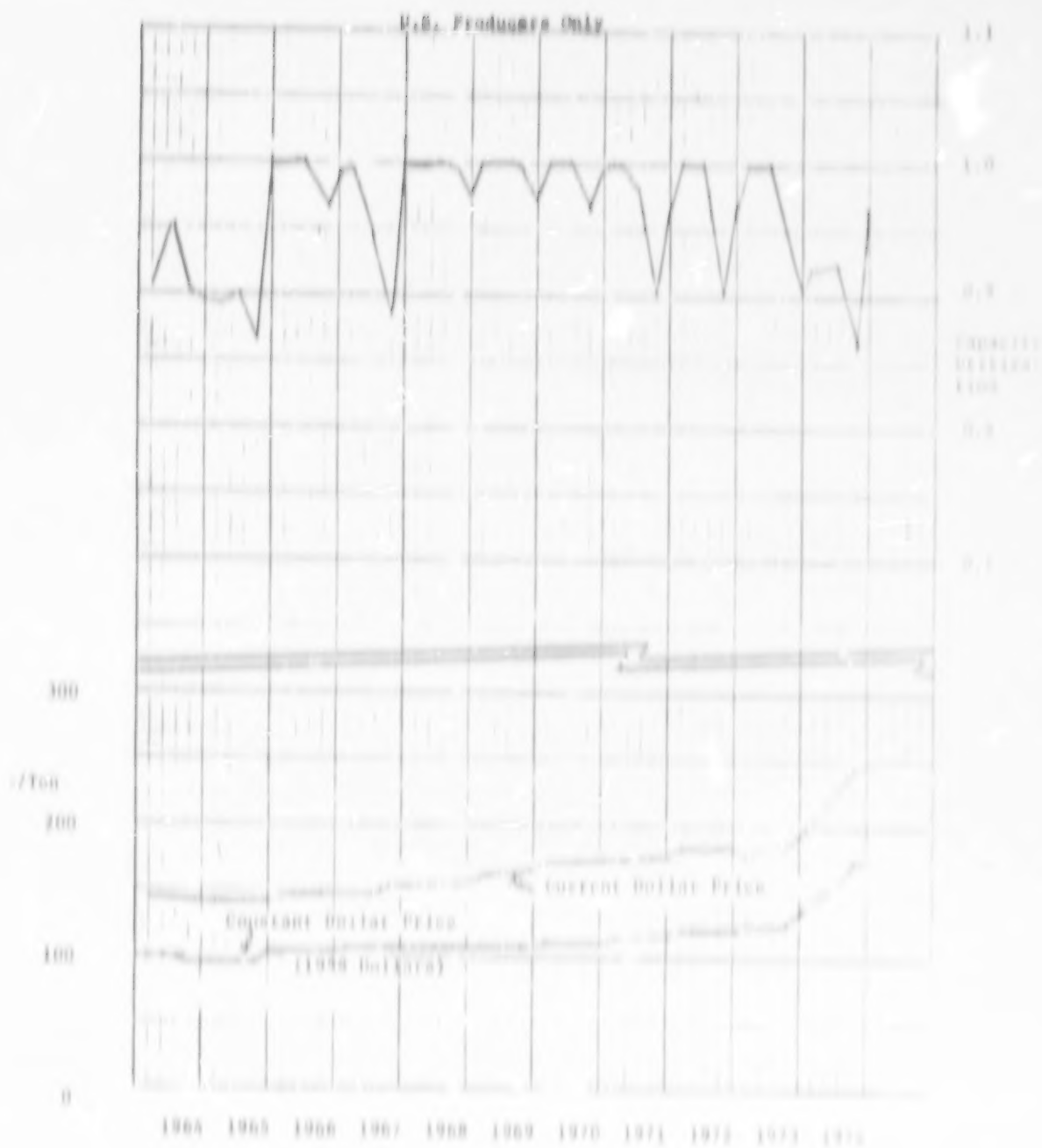


TABLE III-36

EFFECT OF ENVIRONMENTAL REGULATIONS ON RESIDENT PRICES

Environmental Regulation	Existing Industry		Long-Run Price Increase From 1975 Baseline Price
	Investment Required \$ Millions	Necessary Price Increase \$/ton 1975 Price	
EPA Water			
1977	162	\$10.67	4.08
1983	91	5.99	2.3
SLPS	-	-	-
Federal Air			
SLPS	34	2.31	0.9
SLPS	-	-	-
OSMA Noise	70	1.33	0.5
Total	\$126	\$20.39	7.78

1 1975 Prior \$263

2 Baseline Price \$280

Now Capacity Differential 62

SOURCE: Arthur D. Little, Inc., estimates.

existing industry and the long run increase is that the latter impact is based upon a new mill integrated to semi-bleached kraft pulp whereas a substantial portion of the existing industry employs sulfite, pulp, the effluent of which is more costly to control.

Increases in the price of newsprint will ultimately be reflected in newspaper prices. The long-run price increase of 5.7% will result in a 5.7% increase in newspaper prices (0.56 for a 50c daily paper or 56 for a The Sunday paper).

7. Output Impacts

The long term price increase of 5.7% due to environmental regulations will result in a 4.2% decline in demand based upon the estimated price elasticity of demand of 0.74.

Since two-thirds of the newsprint consumed in the United States is imported from Canada, the decline in demand accompanying a price increase by U.S. producers could be greater if Canadian producers are not required to comply with environmental controls. On the other hand, if chronic excess newsprint capacity persists in North America, price increases to recover costs could take longer to be realized.

8. Supply/Demand Balance

U.S. newsprint producers have traditionally operated at very high operating rates (Figure III-13). High operating rates for U.S. producers have not been the trigger for newsprint price increases. The North American supply/demand balance and the North American operating rate indicates probable price increases.

Two-thirds of U.S. consumption is imported from Canada. The Canadian producers face an excess capacity situation for newsprint over the next few years (the 1976 operating rate was 88.8%). If the upper bound of a "no recession" demand projection materializes in the United States, Canadian imports will increase. During the 1980's, under this scenario, North American capacity will be tight and prices could increase. This demand scenario is highly unlikely, given the trends in factors which influence the newsprint market.

J. SPECIALTY PAPERS

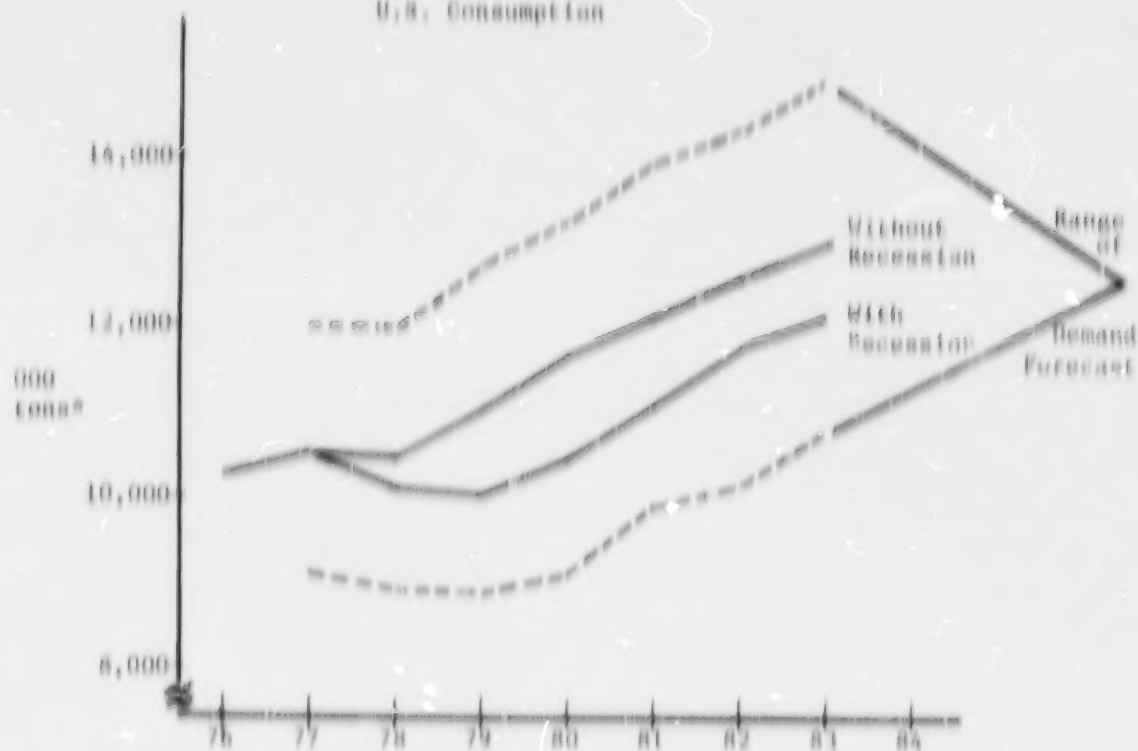
1. Product Description

The specialty papers sector as defined here includes three product groups: special industrial paper, wet machine board, and molded pulp. All three products are specialties in the sense that both the mills and their markets are small and highly specific from the standpoint of product specifications and applications. Because of the specialty nature of this sector, coupled with an unusually high degree of mill variability which affects water effluent problems, the EPA decided to develop guidelines for each mill's water emissions rather than to issue general guidelines. Since these individual guidelines have not been proposed, the specialty paper sector is not included in the economic impact analysis. Capital costs for this sector's capacity expansion and environmental requirements were also excluded from the aggregate industry financial model; however, their exclusion does not affect the model significantly because this sector is small (1.5% of industry capacity) and growing slowly. The description which follows is intended to complete Arthur D. Little's review of the economic characteristics of each of the major pulp and paper industry product sectors, which may provide a useful starting point for future economic analyses.

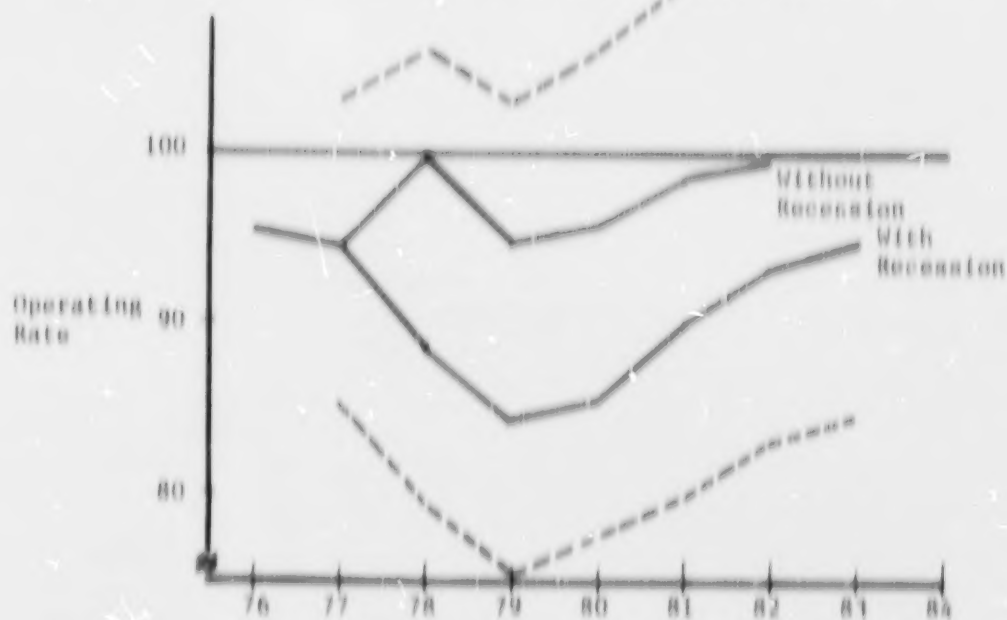
FIGURE 111-13

FORECAST OF NEWSPRINT CONSUMPTION
AND CAPACITY UTILIZATION

U.S. Consumption



Capacity Utilization



* 10 lb. basis weight

The special industrial paper sector comprises a variety of paper and paperboard grades designed for such specialized end uses as abrasive paper, absorbent paper, cable wrapping paper, electrical insulation, vulcanized fiber, and resin impregnating stock. These are for the most part highly technical products sold under exacting specifications to industrial users. They are made from a variety of fibers including bleached kraft and sulfite pulps, unbleached kraft pulp, wastepaper, and cotton.

Wet machine board includes binder board, shoe board (e.g., counterboard, heel board, innersoles, etc.), automotive panel board, chair seat backing, coaster board, luggage board, panel board, and table-top board. This material is formed on cylinder board machines much like recycled paperboard. However, unlike most other paper and paperboard products which are dried by being passed around heated drums, wet machine board is air dried after the paper is formed and dewatered. Its fiber furnish consists almost entirely of wastepaper, supplemented in some cases by nonwood fibers such as cotton.

Molded pulp products include bituminous fiber pipe, egg cartons, packaging trays (for fruits, produce, and food), molded pulp plates and dishes, and various other molded pulp and paper-maché articles. These products are categorized under the Department of Commerce's SIC 3646, which is part of the converted paper products sector. However, the water effluent problems of these mills are closer to those of paper mills than of converting plants. Pulp molding differs from papermaking in that it employs batch rather than continuous operations and much lower water volumes in the pulp molding and pressing operation. While the producers of molded pulp are fairly well represented in the API, their production statistics are not reported by that organization except for the relatively limited data published in the annual Census of Manufactures.

Molded pulp products use wastepaper predominantly (56%) but also consume a substantial amount of bleached and unbleached wood pulp (44%). Wastepaper is used primarily to make egg cartons, while virgin wood pulp is employed for trays and plates.

2. Demand

Since special industrial paper is used in an extremely wide variety of technical and industrial applications, demand correlates well with the industrial production index. From 1964 to 1974, demand grew at an average rate of 4.4% per year. Although there are few direct substitute materials, a number of the end products, such as decorative laminates and luggage, compete with substitute products made from other materials.

Wet machine board demand has remained essentially static since 1964, although there have been year-to-year fluctuations as a result of changes in overall economic activity. For example, because so much of the product goes into shoe innersoles, total demand is influenced by disposable personal income. Since it has many industrial applications, demand for wet machine board also correlates with the industrial output. Over the past 10-12 years, however, demand for wet machine board has remained static because of significant product substitutions. Most important has been the substitution of vinyl plastics in shoe innersoles, and, to a lesser extent, in automotive paneling and luggage.

Molded pulp demand is linked almost entirely to consumer disposable income with the exception of the component used for bituminous fiber pipe. The Department of Commerce data on production, imports and exports, is very sketchy and neither the API nor other trade associations collect statistics on this industry sector. The Department of Commerce data indicates that production has been essentially static for the total industry since 1984. Significant product substitutions have occurred in several molded pulp sectors, particularly in egg cartons and meat trays, which have been displaced by foamed polystyrene plastic.

3. Supply

Most special industrial paper is produced in the Northeast (57%), the South (22%), and the North Central (19%) regions. In 1974, 77% of U.S. capacity was held by 71 mills not integrated to pulp, while 18 integrated mills made up the remaining 23% of capacity. Table III-30A indicates that the supply of special industrial paper is not particularly concentrated, with the top eight producers accounting for 49% of total capacity and the top two producers for 16.6%.

Wet machine board is produced primarily in the Northeast, which accounts for about 80% of the U.S. capacity. The balance comes from the North Central (18%) and Southern (12%) regions. Table III-37 shows that wet machine board capacity is very concentrated at the top; the largest two producers account for over 55% of the total U.S. capacity.

The molded pulp sector is also heavily concentrated at the top; the two largest producers operate 11 of the 26 U.S. molded pulp mills (Table III-38). Capacity statistics seldom are reported for any of these mills. However, the two largest producers probably have more than 50% of U.S. capacity. The balance is fragmented among 13 producers.

Molded pulp production is distributed fairly evenly over the major U.S. regional subdivisions. Of the 26 molded pulp mills, nine are located in the Northeast, seven in the North Central, six in the West, and four in the South. The evenness is caused primarily by the fact that the various molded pulp products require either virgin wood pulp or wastepaper raw materials.

4. Prices

Because of their low volume and fragmented applications, no published price series were found for the specialty paper sectors. Future studies that wish to analyze this sector economically will have to resort to producer surveys not only for price information, but also for molded pulp production and/or shipment data.

In view of the industrial orientation and specialized nature of the grades included, it is reasonable to assume that this sector's rate of price increase since 1971 has approximated the paper industry average. Special industrial paper prices probably rose fastest (close to the rate for printing/writing papers) while wet machine board prices probably have experienced the smallest increase since 1971.

5. Import/Export Trends

Special industrial paper is the only component in the specialty paper sector with significant trade (mainly exports). In 1974, exports of special industrial paper reached a high of 117,000 tons, or 20% of production, while imports were 2,000 tons, or 0.5% of consumption. U.S. technical know-how in achieving required product properties, coupled with large mills (relative to those in Europe and Canada) is probably the main reason for this favorable trade balance.

TABLE III-36A

CONCENTRATION OF U. S. SPECIAL INDUSTRIAL PAPER SUPPLIERS, 1975

<u>Company</u>	<u>% of U.S. Total</u>	<u>Number of Mills</u>
Brown	9.4	2
Union Camp	7.1	1
Scott	6.7	1
St. Regis	6.5	2
Hollingsworth & Vose	6.5	4
Riegel	6.1	4
Knowlton Brothers	4.0	2
James River	3.8	2
Top eight companies	42.1	
Other suppliers (about 43 companies)	<u>57.9</u>	
Total	100.0	

Sources: Lockwood's Director of the Paper and Allied Trades, 1975

Arthur D. Little, Inc., estimates.

TABLE 111-37

CONCENTRATION OF U.S. WET MACHINE BOARD SUPPLIERS, 1975

COMPANY	U.S. \$ TOTAL	NUMBER OF MILLS
Davey	13.8	1
Teson	22.1	2
Colonial Fibre	17.6	1
Spaulding Fibre	4.4	2
George Jenkins	3.7	1
Shryock Brothers	3.7	1
Rogers Corporation	1.5	1
Aiton Leatherboard	<u>1.5</u>	<u>1</u>
Top Eight Companies	88.3	14
Other Suppliers (3 Companies)	<u>11.7</u>	<u>3</u>
Total	<u>100.0</u>	<u>17</u>

Sources: --Lockwood's Directory of the Paper and Allied Trades, 1975

--Arthur D. Little, Inc. Estimates

TABLE III-38

CONCENTRATION OF U. S. MOLDED PULP SUPPLIERS, 1975⁽¹⁾

Company	Number of Mills
Diamond International	6
Keyer Fiber	5
Packaging Corp. of America	2
Formax Containers	2
Fiber Form	1
General Holding Corp.	1
Henry Molded Products	1
Kerdiag Inc.	1
Lane Pulp Holding	1
Molded Container	1
Old Towne Pulp Products	1
Packaging Co. of California	1
Pennsylvania Egg Carton	1
Tekmold, Inc.	1
Woodstream Corp.	1

(1) Based primarily on number of mills since capacity figures are not publicly available for much of this sector

Source: Lockwood's Director of the Paper and Allied Trades, 1975.

U.S. trade in wet machine board is much more modest in absolute terms, but not in relative terms. In 1974, exports were about 11,000 tons (9% of production) while imports totaled 5,000 tons (5% of consumption). The predominant use of wastepaper raw material limits any trade advantage among the industrialized countries where the product is both produced and consumed. However, the United States accounts for nearly all of North and South America's capacity and hence is the dominant supplier for both continents.

There are no published statistics on molded pulp imports or exports. This is a relatively low-value product which faces high duties in most countries. Therefore, it is unlikely that its imports or exports are significant.

APPENDIX
PRODUCT SECTOR
PRICE SERIES AND ECONOMETRIC EQUATIONS

PRODUCT SECTOR PRICE SERIES
(dollars per ton)

<u>YEAR</u>	<u>BLEACHED HARDEN PULP</u>	<u>DISSOLVING PULP</u>	<u>TISSUE</u>	<u>GSS BOARD</u>
1968	136	176	422	178
1969	139	182	447	183
1970	162	195	467	187
1971	162	203	489	187
1972	163	208	495	195
1973	193	207	507	226
1974	295	300	638	293
1975	351	398	769	353

<u>YEAR</u>	<u>NEWSPRINT</u>	<u>PRINTING & WRITING</u>	<u>UNBLEACHED KRAFT PAPER</u>
1968	142	299	128
1969	147	309	143
1970	152	308	158
1971	157	304	147
1972	165	318	163
1973	175	373	177
1974	210	515	211
1975	260	591	263

<u>YEAR</u>	<u>UNBLEACHED KRAFT BOARD</u>	<u>CONTAINERBOARD NBBG</u>	<u>RECYCLED BOARD</u>
1968	107	101	123
1969	117	110	122
1970	120	112	124
1971	119	113	124
1972	126	119	129
1973	142	136	150
1974	180	169	206
1975	195	193	215

ECONOMETRIC MODELS

1. FORMULATION OF MODELS

To identify the potential impacts of Federal pollution control requirements, the economic relationships described so far were combined into a model which included:

- Industry supply functions.
- Market demand functions.

Initially, capacity growth functions were estimated but the equations were not reliable. Announced industry commitments for net capacity expansion as published by the API were combined with simple extrapolation for the years 1980 through 1983 to examine capacity pressures.

Demand equations and supply equations were specified for many of the product sectors studied in this report. The demand equation included a macro-economic variable to represent the income effect, the transaction price of the product and for those sectors with substitute products (bleached board and unbleached kraft paper), the price of the predominant plastic substitute, which was incorporated in the form of a ratio to the price of the product. Due to the fact that the price of substitute products has moved with the prices of paper goods in the studied period (multi-collinearity) and perhaps the use of aggregate product group price data, the elasticity of substitution could not be measured for these products.

For some of the product sectors and for the industry aggregate equation, the specified supply equation did not explain a large percentage of the movement in prices. Prices of paper products correlated best with the price of energy. For many of the low-valued product sectors, capacity utilization rates were inversely related with price — a statistical oddity rather than a real phenomenon.

2. STATISTICAL TECHNIQUE

In product sectors where variable cost explained price movements in a consistent fashion, the two-stage least squares statistical technique was used to estimate the parameters of the demand equation. In other sectors, ordinary least squares, with a lagged price term, was used to estimate the parameters of the demand equation. The equations for the individual product sectors are part of Volume II, while equations for the aggregate of all paper and paperboard are at the end of this Appendix.

3. ERROR IN VARIABLES

The product sector groupings used in this report were based upon similarity of process and market. In aggregating across products in a product group, some of the effects may have been obscured. Also, on the supply side, wood, labor and energy prices were paper industry aggregates and not specific to individual products.

Although an effort was made to use consistent data throughout the historic period, changes in the base capacity and products classified in one grade versus another may have introduced error to the data base.

4. LIMITATIONS OF ECONOMETRIC ANALYSIS

The econometric equations were used to estimate future demand for paper products through 1980 and the reduction in demand that will occur as a result of price increases. Based upon the differences between Equation 1 and Equation 2, the underlying structure of the demand for paper products could still be changing; the full effects of the price increases of 1974-75 may not be yet fully reflected in the marketplace. The impact of this is that the forecast demand levels may be too high.

An upper and lower boundary forecast was made to indicate the expected variation from the forecast due to the equations. Additional differences from the forecast can arise from changes in the underlying demand structure for paper and paperboard and errors in the Chase Econometric forecast.

5. PRODUCT SECTOR EQUATIONS

The econometric equations for the product sectors appear on the following pages. They represent the demand equation actually used in the analysis and to forecast output growth and elasticity of demand.

SECTOR: BLEACHING BOARD, A. BRISTOLS

DEMAND EQUATION:

$$\text{Quantity} = 172.49 - 1.54 \text{ PRICE} + 1.5939 \text{ GNP}_{t-2}$$

Right Hand Variable	Estimated Coefficient	T-Statistic
PRICE	-1.54077	-1.92972
GNP $t-2$	1.59393	9.57261
Constant	172.491	1.23087

$$R^2 = .7626$$

$$\text{Standard Error} = 4.46\%$$

$$\text{Durbin Watson (adj. for 0 gaps)} = 1.5609$$

$$\text{Mean Value of } Q = 1,134$$

$$F\text{-Statistic (2, 29)} = 46.5765$$

Time Period: 1967-1974

Method: 2-Stage Least Squares

SUPPLY EQUATION:

$$\text{Price} = 2.11 \text{ LABOR} + .66 \text{ PULP} - 1.6099 \left(\frac{Q-Q_c}{Q_c} \right)$$

Right Hand Variable	Estimated Coefficient	T-Statistic
LABOR	2.11	12.5007
PULP	.66	15.1013

$$\frac{Q-Q_c}{Q_c} \text{ (\% idle capacity)} = -1.6099 \quad = .0357$$

$$R^2 = .7611$$

$$\text{Standard Error} = 4.73\%$$

$$\text{Durbin Watson (adj. for 0 gaps)} = 1.2464$$

$$\text{Mean Value of } Y = 145.84$$

Time Period: 1967-1974

Method: Ordinary Least Squares

SECTOR: TOTAL BLEACHED PULP

$$\text{CONSUMPTION} = -2.59011 \text{ MARKET PRICE} + 5.70859 \text{ ONP}_{t-2} \\ + 169.998 \text{ WAGE PRICE FREEZE}$$

Right Hand Variable	Estimated Coefficient	T-Statistic
MARKET PRICE	-2.59011	2.26267
ONP _{t-2}	5.70859	28.1119
WAGE PRICE FREEZE	169.998	1.04110

$$R^2 = .9629$$

$$\text{Standard Error} = 3.85$$

$$\text{Durbin Watson} = 1.3270$$

$$\text{Mean Value of Y} = 1760.05$$

Time Period = 1964 - 1974, quarterly

Method: Two-Stage Least Squares

SUPPLY EQUATION:

$$\text{PRICE} = 3.36258 \text{ WOOD} + 5.50454 (\text{LABOR} + \text{ENERGY}) \\ -178.635 \text{ IDLE CAPACITY}$$

Right Hand Variable	Estimated Coefficient	T-Statistic
WOOD	3.36258	6.55914
LABOR + ENERGY	5.50454	7.89451
% IDLE CAPACITY	-178.635	3.01970

$$R^2 = .5275$$

$$\text{Mean of Y} = 123.47$$

$$\text{Durbin Watson (adj. for 9 gaps)} = .3714$$

Time Period: 1964-1974

$$\text{Standard Error} = 10.875$$

Method: Ordinary Least Squares

SECTOR: DISSOLVING PULP

DEMAND EQUATION:

$$\text{PRODUCTION} = 371.185 - 1.31388 \text{ PRICE}_{t-2} + 3.6981 \text{ HOUSEHOLDS}$$

Right Hand Variable	Estimated Coefficient	T-Statistic
Constant	371.185	2.62175
PRICE _{t-2}	-1.31388	2.18955
HOUSEHOLDS	3.69810	3.29564

$$R^2 = .5152$$

$$\text{Standard Error} = 5.935$$

$$\text{Durbin Watson (adj. for 0 pops)} = 1.2720$$

$$\text{Mean of Y} = 405.977$$

$$F\text{-Statistic (2,4)} = 2.15533$$

Time Period: 1964-1976, quarterly

Method: Ordinary Least Squares

SECTOR: AIRSPRINT CONSUMPTION

DEMAND EQUATION:

$$\text{PRODUCTION} = 2761.53 - 13.07 \text{ PRICE}_{t-4} + 13.13 \text{ IIP}$$

Right Hand Variable	Estimated Coefficient	T-Statistic
Constant	2761.53	5.62
Price _{t-4}	-13.07	4.03
IIP	13.13	3.11

$$R^2 = .19$$

Durbin Watson (adj. for 0 gaps) = 1.61

Mean of Y = 2655

F-Statistic (2,41) = 9.1

Standard Error = 7.2%

Time Period: 1968-1976, quarterly

Method: Ordinary Least Squares

Product Sector: N880 Corrugating H₂O

$$\text{CONSUMPTION} = b_0 + b_1 \text{Price} + b_2 \text{GDP}$$

Variable	Value of Coefficient	t-Statistic
Constant (b_0)	-685.50	4.63
Price	-3.231	3.67
GDP	2.214	14.065

Statistics

$$R^2 = .88$$

Standard Error: 4.9

Durbin Watson = 1.246

Mean of Y: 914

Number of Observations = 32

Time Period: 1968-1975, quarterly

F-Statistic (2, 29) = 108.2

Method: Two-Stage Least Squares

$$\text{PRICE} = C_0 + C_1(\text{labor} + \text{energy} + \text{wood}) + C_2\left[\frac{Q}{C}(\text{labor} + \text{energy} + \text{wood})\right]$$

Variable	Value of Coefficient	t-Statistic
Constant (C_0)	18.09	2.12
Labor + Energy + Wood	2.64	10.22
Production Capacity (Labor + Energy + Wood)	-1.61	8.22

Statistics

$$R^2 = .78$$

Standard Error: 5.0

Durbin Watson = .93

Mean of Y: 88

Number of Observations = 32

Time Period: 1968-75, quarterly

F-Statistic = 52.57

Method: Ordinary Least Squares

SECTOR: PRINTING & WRITING

DEMAND EQUATION:

$$\text{QUANTITY} = -440.5 - 3.35267 \text{ PRICE} + 32.6263 \text{ IIP}_{t-2}$$

Right Hand Variable	Estimated Coefficient	T-Statistic
PRICE	-3.35291	3.6946
IIP _{t-2}	32.6262	14.2989
Constant	-440.522	2.163

$$R^2 = .8979$$

$$\text{Standard Error} = 3.765$$

Durbin Watson (adj. for G gaps) = 1.0938

Time Period: 1967-1974

Mean of Y = 2336.41

Method: Two Stage Least Squares

SUPPLY EQUATION:

$$\text{PRICE} = 3.984 \text{ LABOR} + (.111 \times 10^{-10}) \frac{1}{(\frac{C-Q}{C})^{20} \times 10^{20}} + .942 \text{ PULP}$$

Right Hand Variable	Estimated Coefficient	T-Statistic
LABOR	3.427	8.98940
$\frac{1}{(\frac{C-Q}{C})^{20} \times 10^{20}}$	$.518 \times 10^{-10}$	3.32091
PULP	1.11093	11.2001

$$R^2 = .7559$$

$$\text{Standard Error: } 5.895$$

Durbin Watson (adj. for G gaps) = 1.2200

Time Period: 1967-1974

Mean Value of Y: 243.631

Method: Ordinary Least Squares

Product Sector: RECYCLED BOARD

$$\text{CONSUMPTION}_t = b_0 + b_1 \text{Price}_{t-2} + b_2 \text{Index of Industrial Production}_t + b_3 \text{Paper Operating Rate}$$

Variable	Value of Coefficient	t-Statistic
Constant (b_0)	481.66	.824
Price $_{t-2}$	-6.50	2.59
Index of Industrial Production	6.97	2.94
Paper Operating Rate	1253.05	2.39

*Not statistically significant or different from zero.

Statistics

$R^2 = .75$

Standard Error: 5.25

Durbin Watson = 1.15

Mean of Y: 1802

Number of Observations: 30

Time Period: 1968-1975; quarterly

F-Statistic (3, 26) = 25.58

Method: Ordinary Least Squares

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DEMAND EQUATION:

$$\text{Quantity} = 712,256 + 1.60956 \text{ PRICE} + 1.48279 \text{ PERSONAL CONSUMPTION}_{t-2}$$

<u>Right Hand Variable</u>	<u>Estimated Coefficient</u>	<u>T-Statistic</u>
PRICE	-1.60956	5.03400
PERSONAL CONSUMPTION _{t-2}	1.48279	12.4979
Constant	712,256	5.87949

$R^2 = .8555$ Standard Error = 3.655
Durbin Watson = 1.3100 Mean Value Y = 908,672
F Statistic (2,33) = 97.7077
Time Period: 1966-1976, quarterly
Method: Two-Stage Least Squares

SUPPLY EQUATION:

$$\text{Price} = 1.15026 \text{ PRICE} + 1.55377 \text{ LABOR} \\ = 148,522 ((C = Q)/C)$$

<u>Right Hand Variable</u>	<u>Estimated Coefficient</u>	<u>T-Statistic</u>
PRICE PULP	1.15026	10.6108
PRICE LABOR	5.55477	14.4451
C = Q/C (% idle capacity)	-148,522	1.84829

$R^2 = .4776$ Standard Error = 5.255
Durbin Watson = 1.7022 Mean Value Y = 302,958
Time Period: 1966-1976, quarterly
Method: Ordinary Least Squares

Product Sector: UNBLEACHED KRAFT PAPER

$$\text{CONSUMPTION} = b_0 + b_1 \text{ PRICE}_{t-1} + b_2 \text{ GNP}_t$$

Variable	Value of Coefficient	t-Statistic
Constant (b_0)	-1551.29	1.61
PRICE_{t-1}	-13.26	3.59
GNP_t	6.96	11.71

Statistics

$R^2 = 81$

Standard Error: 5.95

Durbin Watson = 1.07

Mean of Y: 3425

Number of Observations = 32

Time Period: 1969-1975, quarterly

F-Statistic (2, 29) = 69.03

Method: Ordinary least squares

Product Sector: UNBLEACHED RAFT PAPER (Equation 1: without substitution)

$$\text{CONSUMPTION}_t = a_0 + a_1 \text{Price}_{t-1} + a_2 \text{GNP}_t$$

<u>Variable</u>	<u>Value of Coefficient</u>	<u>t-Statistic</u>
Constant (a_0)	937.5	7.62
Price_{t-1}	-5.68	6.85
GNP_t	0.80	5.58

Statistics

$R^2 = .66$

Standard Error: 4.7%

Durbin Watson = 1.63

Mean of Y: 924.7

Number of Observations = 15

Time Period: 1967-1973, quarterly

F-Statistic (2, 12) = 31.37

Method: Ordinary Least Squares

Product Sector: UNBLEACHED KRAFT PAPER (Equation 2) with substitution

$$\text{CONSUMPTION} = b_0 + b_1 \text{Price}_{t-2} + b_2 \frac{\text{Price}_{t-2}}{\text{Substitution Price}_{t-2}} + b_3 \text{GDP}$$

Variable	Value of Coefficient	t-statistic
Constant (b_0)	1114.20	8.05
Price_{t-2}	-6.39	7.59
$\frac{\text{Price}_{t-2}}{\text{Substitution Price}_{t-2}}$	58.2659*	1.53*
GDP	0.583	2.66

*Not statistically different from zero at 95% confidence interval

Statistics

$$R^2 = .75$$

Standard Error: 4.05

Durbin Watson = 1.32

Mean of Y: 934.4

Number of Observations = 30

Time Period: 1968-1975, quarterly

F-Statistic (3, 26) = 25.9

Method: Ordinary Least Squares